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GALL-BLADDER DIAGNOSIS FROM THE STANDPOINT OF THE SURGEON¹

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THE frequency of disease of the gall bladder is now attested by the fact that it constitutes the most common organic cause of dyspepsia. Evidence for this statement is found in the careful statistical studies of Blackford and Dwyer² and of Eusterman.³ The importance of accurate methods of diagnosis is therefore obvious.

As in most other conditions, accuracy of diagnosis depends upon an accurate knowledge of the pathology present. Since it would carry us too far afield to discuss in this paper the detailed pathology of cholecystitis, I shall discuss only certain features of the pathology which seem not to be generally known and which seem to me to be of paramount importance in the interpretation of certain diagnostic aspects of the condition.

In 1918 attention was called to the fact that hepatitis is a constant accompaniment of cholecystitis.⁴ The inflammation in the liver is chiefly present in the interlobular sheaths and appears to be a pericholangitis. The constancy of this finding has been confirmed by others, for example, Judd⁵ and Heyd, Killian and MacNeal,⁶ and it seems now to be generally admitted. If this hep-

atitis continues for a sufficient length of time, the typical picture of a well-marked biliary cirrhosis is present, with enormous thickening of the walls of the intrahepatic bile ducts, atrophy of the lobules, fibrosis and contraction of the capsule of the liver, etc. The older conception, therefore, of the necessary presence of the factor of biliary obstruction in the production of biliary cirrhosis has been found to be erroneous. In later work, in association with Peterman and Priest, we^{7,8} showed that cholecystitis nearly always begins in the wall of the gall bladder and not in the mucous membrane. It is almost impossible to infect the mucous membrane of the gall bladder experimentally by the introduction of bacteria into the lumen unless the cystic duct is ligated, the blood supply impaired, or foreign bodies be present in the gall bladder to traumatize the mucosa. Moreover, it is well known that large numbers of bacteria are present in the gall bladder at various times, probably constantly, without producing any inflammation of it. In this respect the situation in the gall bladder is not unlike that in the urinary bladder in that it is well known that bacilluria frequently occurs without cystitis. It is apparent, there-

¹ Read before the Radiological Society of North America, at Cleveland, Dec., 1925.

² BLACKFORD, J. M., and DWYER, M. F.: Gastric Symptoms, with Particular Reference to Gall-bladder Disease. *Jour. Am. Med. Assn.*, 1924, LXXXIII, 412.

³ EUSTERMAN, G. B.: *Ibid.*, p. 415, discussion.

⁴ GRAHAM, E. A.: Hepatitis: A Constant Accompaniment of Cholecystitis. *Surg., Gynec. and Obst.*, 1915, XXVI, 521.

⁵ JUDD, E. S.: Relation of the Liver and Pancreas to Infection of the Gall Bladder. *Jour. Am. Med. Assn.*, 1921, LXXVII, 197.

⁶ HEYD, C. G., KILLIAN, M. A., and MACNEAL, W. J.: The Liver and its Relation to Chronic Abdominal Infection. Beaumont Foundation Lectures, 1924, C. V. Mosby Co., St. Louis.

⁷ PETERMAN, M. G., PRIEST, W. S., JR., and GRAHAM, E. A.: The Association of Hepatitis with Experimental Cholecystitis and its Bearing on the Pathogenesis of Cholecystitis in the Human. *Arch. Surg.*, 1921, II, 92.

⁸ GRAHAM, E. A., and PETERMAN, M. G.: Further Observations on the Lymphatic Origin of Cholecystitis, Cholelithiasis and the Associated Pancreatitis. *Arch. Surg.*, 1922, IV, 23.



Fig. 1. Cholecystogram in normal subject four hours after intravenous injection of sodium phenoltetraiodophthalein in a dose of 0.055 gram per kilogram.



Fig. 2. Cholecystogram of the same individual eight hours after injection. The density of the shadow is no greater, and, if anything, slightly less, than that at the end of four hours.

fore, that caution is needed in interpreting the finding of bacteria in the bile from the gall bladder.

There are essentially two ways by which bacteria can readily enter the wall of the gall bladder. One is through the blood stream, as already emphasized by Rosenow, and the other is through the lymphatics. There is a very extensive anastomosis between the lymphatics of the liver and the gall bladder, and injection experiments show that the lymph stream runs both from the liver to the gall bladder and *vice versa*. The lymphatics enter the gall bladder at its periphery. It is apparent, therefore, that infection of the liver, by following the ordinary laws of the spread of infection, would involve the lymphatics of the gall bladder and that a peripheral lymphangitis of the gall bladder would result. From there the infection may or may not spread to the mucosa. There is an abundant amount of evidence, both experimental and pathological, which supports this idea. It also becomes clear that any lesions which predispose to a hepatitis are likely to predispose to a cholecystitis. Inflammations anywhere along the portal system are likely

to result in the production of a hepatitis. It is, therefore, not surprising that cholecystitis is often associated with the most frequent inflammatory lesions of the portal system, namely, appendicitis, peptic ulcer, typhoid fever, etc. Moreover, there is evidence to show that a vicious circle may exist between the liver and gall bladder, whereby each may reinfect the other through the lymphatics. There is additional evidence also that the infection spreads along the lymphatics of the common duct and may also spread into the pancreas to produce the interstitial type of pancreatitis recognized as associated with chronic cholecystitis.

Cholecystitis, therefore, is a condition demanding serious attention, not so much because the gall bladder itself is involved as because this inflammation carries with it an involvement of the liver and pancreas, both of which organs are necessary for life. For the same reasons also it is important that a diagnosis be established as early as possible in order to protect these vital organs from the effects of long continued infection.

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The ordinary clinical diagnosis of cholecystitis is usually based upon findings which are really expressions of comparatively late effects, or sequels, of the involvement of the gall bladder. When these are typical the diagnosis is, of course, easy. But obviously it would be desirable to have a means of recognizing the disease before it has produced its late effects, when the pathological changes are still insignificant. Indirect methods at present available are of a kind which can recognize only the comparatively late effects. I refer to such methods as (1) the ordinary X-ray examination which seeks for stones, adhesions or thickening of the gall bladder; (2) tests of liver function or of the amount of bile constituents in the serum. I am not quite sure whether to include the Lyon test in this category or not, but I am inclined to think that its greatest value must of necessity be in the relatively late cases. It is fortunate that Dr. Lyon is to follow me in this symposium so that he can refute this statement if he so wishes.

Disturbed function of an organ is one of its earliest manifestations of inflammation. Would it not be desirable, then, to have some means of studying directly the function of the gall bladder so that early and mild cases of cholecystitis could be recognized? In the method of cholecystography we have a means by which we can examine the only two functions of the gall bladder which have been so far discovered, namely, the function of concentrating its contained bile and the function of regulating the pressure within the system of biliary ducts. By this method a normal gall bladder will show an increasing density of its shadow during a certain period, indicating the presence of the power of concentration, and it will also show changes in its size which indicate distensibility, or a power to regulate pressure changes in the biliary tract. Cholecystography is pre-eminently a functional test of the gall bladder, and it does not necessarily reveal the exact pathological lesions. For this reason it should be emphasized that a failure to obtain a visualization of the gall



Fig. 3. Cholecystogram of the same individual twenty-four hours after injection. The shadow has disappeared.

bladder does not signify, as many have thought, an obstruction of the cystic duct. It may signify that, but it may equally well signify merely a failure in the power of the gall bladder to concentrate its contained dye sufficiently to cast a shadow. Theoretically, also, it may signify a sufficient disturbance of liver function to prevent excretion of the substance. Practically, however, we have not found that under ordinary circumstances the function of the liver is enough impaired to necessitate the consideration of this point. But because cholecystography is a functional test, we believe that it provides a more accurate method of recognizing early and mild cases of cholecystitis than any other method. Incidentally, also, it does very often reveal stones, adhesions, etc., which were not revealed in other ways. Whether or not it will reveal stones in as many cases as the painstaking skill of Dr. George will, remains to be seen. I shall not discuss here the details of our experience with cholecystography, since those features will be covered to some extent by Dr. Zink. The ultimate evaluation of this procedure will be chiefly made by you radiologists, upon whom will rest the burden of the interpretation of the films.

Another aspect, however, of the diagnosis of cholecystitis which needs consideration is the question of the recognition of it at operation. What are the criteria upon which a diagnosis of cholecystitis shall be based after the abdomen has been opened? In our own work we use the following: (1) Stones. We feel that all gall bladders which contain stones also have some degree of associated cholecystitis. (2) Adhesions of the gall bladder to surrounding structures. Adhesions are a definite indication of previous or existing inflammation. (3) Thickening and change of color. In chronic disease the wall of the gall bladder loses its normal slate blue color and becomes gray as it becomes thicker from edema, leukocytic infiltration or fibrosis. (4) Enlargement of the "sentinel" gland of Lund. This lymph gland is located at about the junction of the cystic and common ducts. It receives lymph drainage from the gall bladder, and if it is distinctly enlarged it is usually an indication of an existing cholecystitis. (5) Evidence of hepatitis chiefly involving the right lobe of the liver. In acute or subacute cases of cholecystitis the liver (especially the right lobe) is more or less enlarged from edema. In the chronic cases the capsule is generally marked by striations of fibrosis, and in the extreme cases a well-marked biliary cirrhosis is present. (6) We very occasionally open a gall bladder to examine its mucous membrane. We feel that the cholesterol plaques seen in the so-called "strawberry" gall bladder are indicative of inflammation. But in view of what we have already said about the origin of cholecystitis in the wall rather than in the mucosa of the gall bladder, we feel that we can nearly always recognize the signs of its presence without opening the organ. As we have gained greater confidence in the significance of the cholecystographic findings we have on several occasions removed gall bladders which seemed practically normal on inspection and palpation but which microscopically showed rather extensive infiltration of the walls with polymorphonuclear leuko-

cytes, thus verifying the cholecystographic diagnosis. If we think of cholecystitis as beginning with a peripheral lymphangitis in many instances, it is easy to understand how early thrombosis of the lymphatic vessels in such cases will result in an impaired concentrating power of the gall bladder, with the result that a failure to obtain a shadow will sometimes occur even in a comparatively early or mild case of cholecystitis without much gross pathological change.

In brief, in a series of seven hundred cases which have been examined by cholecystography we have found this method more accurate than any other. In several instances it has furnished positive evidence of the nature of the patients' trouble when clinical evidence was misleading, as, for example, in two cases of pain in the left upper quadrant. In both of these cases evidence of disturbed function of the gall bladder was obtained by cholecystography and the removal of chronically inflamed gall bladders relieved the symptoms. Our percentage of correct diagnoses by this method still averages 93 per cent.

Since the beginning of our work on cholecystography an effort has been made to find a substance which would not only prove practical for visualizing the gall bladder but would also give sufficient color to the blood serum to permit its use as a test of hepatic function, in a manner similar to the test devised by Rosenthal⁹ with the use of phenoltetrachlorphthalein. The substances, however, which we have used chiefly for cholecystography have been tetraiodophenolphthalein and tetrabromphenolphthalein. These substances do not stain the serum sufficiently to be easily recognizable in it even after alkalinization. Their isomeric compounds, however, have a more intense color. The structural formulæ of tetraiodophenolphthalein and of its isomer, phenoltetraiodophthalein, are as follows:

⁹ ROSENTHAL, S. M.: An Improved Method for Using Phenoltetrachlorphthalein as a Liver Function Test. *Jour. Pharm. and Exper. Therap.*, 19:385-391 (June), 1922.

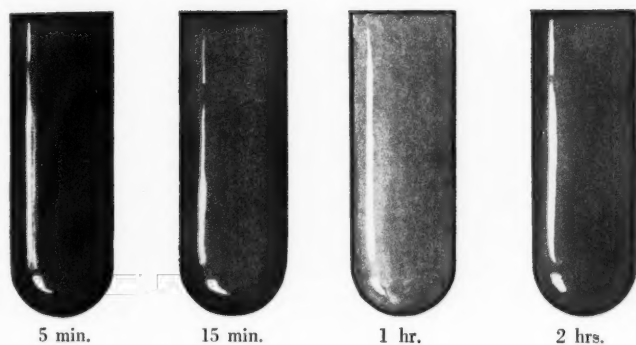
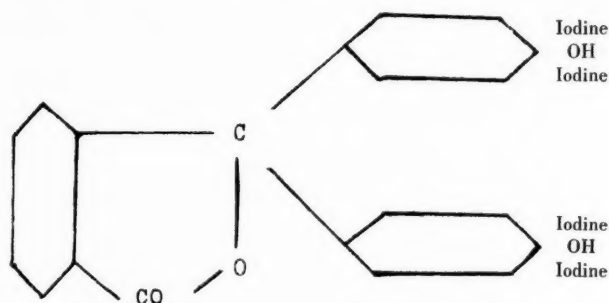


Fig. 4. Color of blood serum after injection of sodium phenoltetraiodophthalein and after alkalinizing the withdrawn serum by the addition of sodium hydroxide. The first three tubes illustrate the color obtained in the serum after the intravenous injection of 0.0275 gm. per kilogram of body weight. At the end of one hour another dose of an equal amount was injected. After two hours, therefore, the color of the serum after alkalinization was a little more intense than after one hour.

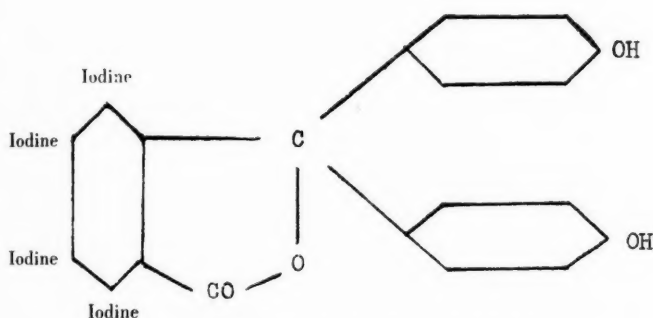
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Structural formula of tetraiodophenolphthalein



Structural formula of phenoltetraiodophthalein

Naturally, therefore, after finding that tetraiodophenolphthalein was a safe and practical agent for rendering the gall bladder visible, we turned to its isomer, phenoltetraiodophthalein, as a substance which might make possible the simultaneous performance of a test of hepatic function and cholecystography. In an article published last September we¹⁰ reported that good cholecystograms could be obtained with this substance. Unexpected difficulty, however, was encountered in the preparation of this substance in satisfactory quantity, and this has delayed the progress of the investigations of it as a means of testing hepatic function.¹¹ We are now prepared to state, however, that the sodium salt of phenoltetraiodophthalein not only makes possible the visualization of the gall bladder, apparently

equally as well as its isomer, sodium tetraiodophenolphthalein, but it also stains the serum sufficiently to enable its detection after alkalinization. Probably the same principles of technic can be applied to its quantitative recognition and to the evaluation of the results as are used in the Rosenthal test. The color obtained, however, is slightly more purple than that due to phenoltetrachlorophthalein. Roentgenograms of the gall bladder of nearly maximum intensity have been obtained in normal subjects within four hours after injection of 0.055 gm. per kilogram of body weight. No general toxic reactions have occurred so far in any of the patients who have been injected, but there has been a slightly greater tendency to venous thrombosis at the site of injection, although apparently this complication can be obviated by washing out the vein with physiological saline solution immediately after the injection. We do not feel that we yet have sufficient knowledge to recommend the

¹⁰ GRAHAM, E. A., COLE, W. H., MOORE, S., and COOPER, G. H.: Cholecystography: Oral Administration of Sodium Tetraiodophenolphthalein. Jour. Am. Med. Assn., 85:953-955, Sept. 26, 1925.

¹¹ The sodium salt of phenoltetraiodophthalein which we have used in this work was prepared for us by the Mallinckrodt Chemical Works of St. Louis.

use of this substance as a substitute for sodium tetraiodophenolphthalein for cholecystography, and we are presenting this information only as a preliminary report. It is possible, however, that further work with it will show that, because of possibly faster excretion through the liver, it will shorten the time now required for a cholecystographic examination by the use of sodium tetraiodophenolphthalein. It may also be possible to secure equally good cholecystograms with much smaller doses of this substance and thereby to eliminate practically all toxic symptoms.

We have not yet tried giving it to patients by mouth because we have not yet been able to obtain enough of it to carry out any more than preliminary observations. It seems reasonable to expect, however, that this substance will prove just as satisfactory for oral administration as sodium tetraiodophenolphthalein. It is, of course, not yet cer-

tain what advantage there may be due to the fact that by means of sodium phenoltetraiodophthalein hepatic functional tests can be performed in addition to cholecystography. The ultimate appraisal of the value of tests of hepatic function based on the excretion of dyes by the liver seems uncertain, in view of the conflicting literature. Another feature, however, of sodium phenoltetraiodophthalein is that, in addition to being excreted in sufficient amount through the liver to give excellent cholecystograms, it is also excreted in sufficient amount through the kidneys to enable its recognition colorimetrically in the urine after alkalization. Thus, it seems probable that by the use of a single dose of this substance simultaneous observations can be made of the renal function, of the hepatic function and of the condition of the gall bladder, a combination of observations which hitherto has been impossible with a single substance.

Gall-bladder examinations.—The author reports variations from the supposed normal in the position of the gall bladder, as observed in a series of 500 gall-bladder examinations with tetraiodophenolphthalein. He states that in the last 200 cases the gall bladder has been sharply and distinctly outlined in 90 per cent of all the normals. In position he finds the average gall bladder much lower than either the text books or previous reports would indicate. In 75 per cent of the cases, the organ extends below the lower limits of the hypochondriac and epigastric regions. Usually it descends into the umbilical region and often into the right lumbar region. Not infrequently it extends outward far beyond the supposed normal limits, reaching almost, or quite, to the axillary wall of the abdomen. It is suggested that many gall-bladder shadows are masked by the spine shadow and that films made with the patient rotated slightly to the left will show many such gall bladders

which would be missed in the straight prone position. A range of motion is reported, with posture, of from one to four inches. Differential diagnosis of lesions in low gall bladders is emphasized. Reasons for failure to obtain a gall-bladder shadow are analyzed and the importance of liver disease, as well as obstruction of the bile passages and inspissation of bile and mucus in the gall bladder and ducts are mentioned. The author states that in the presence of jaundice the gall bladder never outlined with the dye, regardless of the cause of the jaundice. Failure of capsules or pills to dissolve is also mentioned as a frequent source of failure to fill when the oral method is used. This method was the one used in all the cases on which this article is based.

CHARLES D. ENFIELD, M.D.

The Gall Bladder as Revealed by the Roentgen Ray. Sidney Lange. *Jour. Am. Med. Assn.*, Dec. 26, 1925, p. 2021.

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THE EVOLUTION OF EARLY TO LATE GALL-TRACT DISEASE¹

A BRIEF CONSIDERATION OF ITS DIAGNOSIS AND TREATMENT

By B. B. VINCENT LYON, M.D., PHILADELPHIA, PA.

OWING to the limitations of a short paper, it is obvious that any discussion of the medical diagnosis of gall-bladder disease must be the merest outline of the methods to be employed. Nor is it possible to discuss as fully as the subject justifies, the interpretation of findings by these various methods. Furthermore, it must be understood that too much emphasis in past years has been given disease of the gall bladder itself without sufficiently realizing the importance of recognizing what associated conditions are present in the liver and bile ducts, as well as those viscera whose veins empty into the portal circulation.

For generations, history and physical examination was the limit of our diagnostic endeavor and must still remain the cornerstone in diagnosis. The introduction of surgery for the gall bladder, about sixty years ago, permitted visual and tactile proof of the grosser lesions. This pioneer work of a few surgeons gradually developed a larger surgical recognition of "living pathology." This was a great advance.

To-day, we have a practical means of investigating "living histology" during the early breeding periods of the disease which can be compared with the findings in later stages. This method lies in the recognition of the type, degree and source of epithelial exfoliation seen in the microscopic study of duodeno-biliary tract aspirates. To the educated eye of the trained observer the various microscopic pictures give reliable diagnostic values which are not revealed to the inexperienced eye of the tyro. Such diagnostic evidence can be obtained only by expert use of the duodenal tube, and, when positive, serves to correlate or interpret a doubtful history and negative physical examination.

In the early beginnings of cholecystitis or choledochitis, the reaction to low grade inflammation or sub-infection is at first a catarrhal process involving the mucous membranes, with an outpouring of mucus, abnormal denudation of gall-tract or duodenal epithelium, and abnormal numbers of bile-stained lymphocytes or polymorphonuclear leukocytes, depending upon the degree and acuteness of the inflammation. In many instances, the process in this early stage is purely catarrhal, but may involve any portion of the gall tract from liver cells down to the termination of the common duct. If the latter predominates, obstruction of the choledochus takes place and catarrhal jaundice ensues.

The genesis of this condition is well understood, but the danger of this apparently benign disease has been too lightly regarded. If allowed to run its natural course of a week to a month, the back pressure of an obstructed excretory system may produce extensive damage to liver and pancreatic cells, and, to a less extent, gall-bladder and duct cells. It sets the stage for the development of later liver and pancreatic disease or dysfunction. Analyze carefully the histories of cases of well established liver, pancreas or gall-bladder disease and note the frequency of incidence of an antecedent catarrhal jaundice. More doctors should realize the efficacy of duodeno-biliary drainage in shortening the duration of this condition, and thus forestall such damaging pressure effects (1). This applies equally to the jaundice due to obstruction of the minute radicals within the liver which follows the administration of many drugs such as salvarsan, chloroform, phosphorus, etc., and which injures the liver cells if not promptly aborted by duodenal drainage (2).

Too few doctors, however, are aware that this early catarrhal process may, in certain

¹Read before the Radiological Society of North America, at Cleveland, Dec., 1925.

cases, be localized to the cystic duct alone, and produce retention of gall-bladder bile with resultant damage to the gall-bladder mucosa and walls. This condition is accurately recognizable by only two diagnostic procedures: by biliary tract drainage study, or by Graham's cholecystogram method (3). But the latter cannot differentiate between cystic duct obstruction due to catarrh and that produced by adhesions, stone impaction, stricture, angulation of duct, etc. Cystic duct obstruction due to catarrh gives an abnormal drainage sequence and a characteristic microscopical picture. Either no "B" (gall bladder) fraction is recovered, or in small amounts only, and preceded by discharge of characteristic flocculi, of dense yellow-brown mucus, in shaggy, slimy masses. Microscopically, this mucus will be found unusually dense; often spiralled and twisted (by rifling of the cystic duct), and encrusted with bile salts; but most importantly, an oleaginous material (possibly a fatty ester) of a pale to bright yellow color which melts out into globules, pools and lakes. Where infection has taken place and the inflammation has progressed beyond the catarrhal stage, there will be found, in addition, bile-stained colonies of culturally viable bacteria, collections of pus cells and increased exfoliation of bile-stained columnar epithelium. I have heretofore described the microscopical picture characteristic of cholecystitis so that it need not be repeated here. Such an expression of "living histology" antedates the development of gross "living pathology."

The experienced surgeon can recognize by sight and touch the obviously diseased gall bladder, with thickened or paper-thin walls; adhesions to neighboring viscera; calculi within bladder or bile ducts, if readily palpable; enlargement of lymphatic glands; the thickened or fibrotic or sometimes calculus-bearing pancreas; or such portions of the liver edge or its inferior or superior surfaces as visually may indicate liver disease. However, all such "living pathology" indicates late, rather than early, gall-tract disease. In the majority of such

cases, diagnosis by X-ray rarely fails directly, or indirectly, to indicate its presence; and the microscope and culture tube aid us in verifying and classifying post-operatively the degree and nature of the pathology. In this group of late cases, the symptoms and findings are often so classical as to make the presumptive pre-operative diagnosis of gall-tract disease a relatively safe one. But too often, even in this late stage, there is too little operative recognition of the presence of associated abdominal disease. Many of the unsatisfactory recoveries which still follow clean cholecystectomies are due to this fact.

It is not unusual for focal infections in tonsils, teeth, gums, sinuses, bronchial tree, etc., to produce gastric or duodenal ulcer, cholecystitis, appendicitis and colitis in the same patient. This is not clearly enough recognized by the majority of doctors to-day and should be emphasized. This does not mean that infection is the sole etiological factor in any of these diseases, although its presence can be established in a large number. Reference should be made to a recent article by Barker (4), in which he touches upon the various etiological factors in the production of peptic ulcer. To a not inconsiderable extent, many of these same factors apply to the genesis of cholecystitis, appendicitis and colitis. The frequent co-existence of all of these conditions with foci of bacterial infection in neighborhood, or remote parts of the body, is being more constantly observed.

So-called acute gall-bladder disease, if based upon the teaching of a generation ago, really meant chronic gall-bladder pathology, but associated with historical and physical findings representing acute exacerbations, as seen in stone colics and in the diffuse tension phenomena acting upon inflamed gall-bladder and duct walls or mucous membrane or upon inflammatory adhesions. Such attacks occur most frequently in the fourth and fifth decades and we find the incidence increased or maintained in subsequent decades.

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Acute appendicitis is a disease most commonly seen in the second and third decades and which gradually decreases in incidence in its fulminating form as age advances. Likewise, acute duodenal ulcer most commonly appears in the third and fourth decades and advances to the chronic surgically indurated lesion more often after the fourth decade. Although the clinical picture of well established gall-bladder disease is most frequently seen in the fourth and fifth decades, we should not lose sight of the fact that there is a breeding period of low grade mucosal inflammation (usually due to infection), which may antedate the development of clinical symptoms and signs by many years. Eusterman (5), Snyder (6) and others have recently reported cases of cholecystitis and cholelithiasis occurring in youth and early adult life, but these are exceptions to the general rule. Such frank clinical pictures are comparatively rare, yet the breeding period of gall-tract disease often begins at an early age.

How might a new conception of early gall-bladder disease, based on present-day experience, be expressed? Assuming that focal infection in a "dirty" mouth or upper respiratory tract can produce disseminated infection in the gastro-intestinal tract below it, the sequence of events might be outlined as follows: The faucial tonsils are the first barrier lymphatic glands, the first line of defence against bacterial invasion from without. In sequence, come the lingual tonsils and adenoids, and the glands at the roots of the bronchial tree might appropriately be called the "bronchial tonsils." Below the mouth, in the gastro-intestinal tract, there are no important lymphatic tissue defences until the intestines are reached. If the appendix has any function, it might be considered as an accessory lymphatic gland and in the frequency of its infection might be called the "abdominal tonsil." How often do our histories record recurrent attacks of acute follicular tonsillitis in childhood and early adult life, which lessen gradually in frequency and severity as age advances? During this early period, the

tonsils react by inflammatory swelling and push out from their distended crypts, mucus and bacteria which are, to a large extent, swallowed. In each successive attack, the defensive mechanism of the tonsil becomes progressively injured, and scar tissue and fibrotic changes develop. At this stage, it passes into the concealed focal infection type which drains into the systemic blood and disseminates the infection or its toxic products. Thus, infection of the gastro-intestinal tract takes place by two principal routes: by swallowing bacteria of a dosage and virulency beyond the power of the normal bactericidal barriers, such as the gastric juice, the intestinal glands, and the tissue resistance of each individual to contend with, and, secondly, by way of the systemic blood supply. Tissue resistance once broken down, such infection, established in the gastro-intestinal tract, is further disseminated by a third route, namely, the lymphatic channels. Although the proof of the selective affinity of various bacterial strains for specific tissues within the abdomen or joints seems to be well established by Rosenow, it is not unlikely that certain bacterial groups or strains can produce multiple lesions within the gastro-intestinal tract, such as peptic ulcer, cholecystitis, appendicitis, colitis, etc.; but while they may attack these various tissues simultaneously, the clinical phenomena representing such invasions may not appear simultaneously because of differences in structure of these various organs.

There seems to be more than a casual relationship between the frequent co-existence of acute tonsillitis and acute appendicitis in childhood and early adult life; likewise, the early beginnings of duodenal ulcer (or its usual forerunner, duodenitis) and of cholecystitis may occur at this same period, although they may not develop recognizable clinical symptoms or signs until later decades.

As stated, the reason for this may partly lie in structural differences of these various organs. The appendix is a small hollow tube with a narrow lumen and relatively

inelastic walls, richly furnished with lymphoid tissue, which in the stage of acute catarrhal appendicitis swells with mucus and inflammatory edema, and produces tension phenomena at a far earlier period than can occur in the larger and more elastic walled duodenum or gall bladder. This attracts our attention the more readily to the clinical syndrome of acute appendicitis that is rarely misunderstood to-day. Furthermore, the appendix occupies a position within the abdomen that is more readily accessible to palpation, and in acute appendicitis mistaken diagnoses are comparatively rare, except in diaphragmatic and subdiaphragmatic pleurisy, in right renal calculus with pyelitis, or in the crises of cerebrospinal syphilis. On the contrary, the gall bladder is shielded by the right costal arch and the overhanging edge of the liver, and is, with the duodenum, a region more difficult of palpation, so that the earlier beginnings of catarrhal duodenitis and cholecystitis usually give negative physical findings. Too frequently, upper right quadrant exploration during an appendectomy reveals to the surgeon perfectly normal appearances as regards the gall-bladder serosa and walls, and this early stage of catarrhal cholecystitis escapes surgical recognition. Yet, by means of the duodenal tube and the microscopic study of gastric, duodenal and biliary tract fluids, we find the evidence of the inflammatory and exfoliative cellular processes which are taking place, but which may be limited to the mucous membrane. This stage of cholecystitis, when so recognized, is to be considered as a non-surgical disease, and readily curable by a properly planned course of duodeno-biliary drainage.

If not so treated, however, as the semi-decades pass, a group of digestive symptoms gradually develops and masquerades under such mistaken diagnoses as "nervous indigestion," "biliousness," "fermentative dyspepsia," etc. The symptoms are varied and vague and the patient is dieted and drugged or ignored until, by degrees, a symptom group of the ulcer syn-

drome, on the one hand, or the sense of fullness and pressure, or pin-and-needle darting pains in the region of the gall bladder, or above the right costal margin, may develop. Here too, physical findings may often be negative, X-ray diagnostic signs uncertain, and surgical exploration may still disclose no recognizable pathology as viewed from the serosal surfaces. The stages described above represent the breeding period of cholecystitis, cholelithiasis, choledochitis, of duodenitis and ulcer involving their respective mucous membranes. Perhaps pancreatitis could be included here. Only the duodenal tube, the microscope, the culture tube, and, most important, the experienced observer, will recognize this early stage.

The symptoms now progress to more severe upper right quadrant pain attacks, colics and pseudocolics, accompanied by nausea and, less frequently, vomiting; with upper abdominal gaseous distention and belching during the intercurrent periods, and more violently before each impending attack. By degrees, adhesions develop between duodenum or colon or omentum and the gall bladder or inferior surface of the liver. Pain is now more frequently referred around the costal margins or to either shoulder or shoulder-blade, but more commonly the right. At this stage, if the patient is examined during the *interval* period, the physical findings may often still be relatively negative. There may be no muscle rigidity or spasm or palpability of the gall bladder with localized tenderness, or leukocytosis as is commonly seen during the acute exacerbations; but the associated findings may, and frequently do, point to gall-tract disease now well established, in which the liver, ducts and pancreas, as well as the gall bladder, are involved. Deep thumb pressure under costal margins may be greater under the right ribs. The ulnar concussion test is more often definitely positive. Examining along the course of the right intercostal nerves, tender points between the fourth and fifth anterior interspaces may often be found which may be

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traced outward and upward to the spine, where localized thumb pressure produces definite wincing. By this time, there may be evidence of chronic jaundice in the form of increasing sallowness or swarthinness of the skin; the presence of young and old angiomas, or abnormal freckling or "liver spots" on "un-sun-exposed" areas; and perhaps suggestive evidence of portal obstruction in capillary anastomoses and telangiectases above the costal margins. The clinical test (7) for upper right quadrant adhesions by means of the tuning fork will usually be positive. This test, so easy of performance, checks favorably with the X-ray evidence of a deformed duodenal cap (8), and is capable of final proof at the operating table. At this stage, gall-tract disease is well established.

The calculus-bearing period begins early and is recognizable as a *potential* lithiasis only by the microscopic findings of showers of precipitated crystalline elements in the bile fractions. No other means will disclose their presence. From these microscopical beginnings, gall sand and, later on, formed calculi develop by gradual crystalline accretion, which frequently occurs in definite laminae. Whether these microscopic precipitations of crystals represent potential stone formation within the catarrhal or hyperconcentrating gall bladder alone, or whether, due to some inherent (but as yet unknown) defect in liver cells, these crystals are thrown out of solution within the duct radicals, is a problem awaiting final solution. We have considerable microscopical evidence from studies of several thousand bile specimens which suggests that the latter possibility may obtain in many cases. Over-rich cholesterol or calcium diets may account for some of it.

After calculi of gross size have developed, the stone colic phenomena shortly follow if the gall bladder is inflamed. The clinical picture of typical gallstone colic requires no description here, nor can a differential discussion of the diagnostic interpretation of frank skin and scleral jaundice find room in this paper. There is, however,

a condition of a pseudocolic type that in some instances is entirely dissociable clinically from that of gallstones. I have reported such cases (9). The mechanism by which this colic-like pain is produced has been attributed to simultaneous spasm or contractural effort of the gall bladder acting against a tonically contracted sphincter of Oddi, with a rise of intraduct or intracystic tension acting upon inflamed mucous membranes; or to irregular spasmodic contractural effort on the part of an inflamed gall bladder acting against a cystic duct obstruction.

In chronic cholecystitis there are other diagnostic aids of great importance. The expert roentgenologist may visualize positive or negative stone shadows in approximately 50 per cent of cases or the shadow of a thickened gall-bladder wall. Where these findings are absent, evidences of deformity of duodenal cap by adhesions, or duodenal irritation producing reverse peristalsis, often associated with hypermotility of the jejunum and ileum, are frequently and rightly interpreted as indirect signs of cholecystitis. The development of Graham's method of cholecystography, as demonstrated in this symposium, marks a splendid advance in the recognition of gall-bladder pathology. Since it furnishes a silhouette of the gall bladder and evidence of the elasticity or contractility of its walls and the patency or permeability of the cystic duct (and *perhaps* the conductivity of the halogen radical by way of the serosal blood or lymph channels), it is capable of recognizing, in a more definite and convincing way than heretofore, late pathology of a surgical degree; but because it gives no information as to what is the state of mucosal integrity, it still misses recognition of the early cases during the breeding period because the wall of the gall bladder has not become sufficiently damaged. In our cases referred for surgery after total clinical study, our biliary tract drainage findings have almost always told us whether or not the gall bladder is inflamed or infected or calculus-bearing, whether the common duct

is patent, whether the cystic duct is obstructed or permeable, and, furthermore, can distinguish between various types of cystic duct obstruction, one of which (the catarrhal obstructive type) is amenable to non-surgical measures. Our drainage findings may likewise disclose whether or not there is microscopic duodenal retention of 15-hour food remnants due to adhesions, angulations or diverticula. The two latter conditions, however, are more definitely recognized by X-ray study than by any other single pre-operative procedure; the duodenal tube can only suggest these conditions but cannot differentiate them.

Among other tests, the most important is the detection of abnormal amounts of bilirubin in the blood by the van den Bergh test (10) or by the Bernheim icterus index (11), both of which will establish the presence of a latent jaundice. Such a bilirubinemia may be a significant finding in a clinically doubtful cholecystitis, as well as in various forms of hepatitis or cirrhosis or cancer. In the latter groups, the Rosenthal dye test with bromosulphalein (12), especially if combined with the duodenal intubation control method of Aaron, Beck and Schneider (13), or of Piersol and Bockus (14), is a distinct help in recognizing associated impairment of the excretory function of the liver.

The most important need in gall-tract disease is its early recognition, at a time when appropriate measures to prevent late pathology can be undertaken with success. These cases must be studied thoroughly, utilizing all of our diagnostic procedures. The results of appropriate examinations of the urine and stools, of blood chemistry and serology, should be added to the diagnostic data furnished by the history and by the physical and X-ray findings. But, in my opinion, there is no procedure so capable of recognizing the early beginnings of a cholecystitis, involving its mucous membrane, as the intelligent study, by an expert, of the microscopy, chemistry and bacteriology of the duodeno-biliary aspirates. Accurate quantitative methods of analyzing

the chemistry of normal and abnormal bile fractions are still lacking, but it is to be hoped that the clinical researches now being undertaken, particularly by McClure and his associates (15), will shortly show us the way.

The second point is to differentiate properly between the medical and surgical gall bladder. Our experience (9) has convinced us that when recognized early and treated on a comprehensive non-surgical basis with sound dietetics and the use, but minimal use, of appropriate therapy by mouth, the eradication of removable foci of infection, the exhibition of vaccines prepared from such multiple foci, and featured by intensive drainage of the biliary tract system, these earlier cases of gall-bladder and gall-tract disease can be cured, and the function of such gall bladders restored to normal.

Finally, by means of these various diagnostic aids, the surgical gall bladder with recognizable gross pathology and destroyed function, can be segregated from the former group. Such cases should be referred for a cholecystectomy to break the first of three vicious circles which have recently been described (16), but surgical drainage of the common duct, except in the presence of stricture or an otherwise *obstructive* lesion to excretion, should be discontinued and replaced by drainage by means of the duodenal tube, a safer and more effective method. All cases sent for surgery of the gall tract should have a short period of pre-operative non-surgical drainage to prepare the operative field and aid in detoxicating the patient by lifting some of the load from the liver, heart and kidneys; and a period of post-operative non-surgical drainage, when necessary, to take care of residual liver or duct inflammations or infections and prevent a relapsing angiolocolitis.

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Bactericidal action of radiation in cervical carcinoma.—Ruge and Philipp (Bumm's Clinic in Berlin) have worked out a virulence test for germs in cases of cervical carcinoma. They claim that the mortality in patients with carcinoma of the uterus is due to secondary infection caused by virulent germs growing on the necrotic cancer tissue. The indication for operation is, therefore, based on the above-mentioned test. The value of the test has been questioned by other investigators and Zacherl has undertaken a series of experiments to be able to form an opinion of his own. He states that the test is a very valuable help although not an absolute indicator. Not in all cases with a positive test did infection occur, but it is certainly a sign of warning. The two-stage operation is advocated: first, cauterization of the tumor, to be followed after the wound is cleaned, by radical hysterectomy. Radiation treatment in medium doses of very short wave length seems to reduce the virulence of the germs, as shown by the Philipp test before and after the exposure. Great care has to be taken not to over-dose and so injure the tissue.

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The Influence of Radiation on Philipp's Virulence Test in Cases of Cervical Carcinoma. H. Zacherl. *Strahlentherapie*, 1925, Vol. 20, 1, p. 57.

Carbuncles and erysipelas.—The author reports treatment of seventeen large carbuncles, since his last report. He also reports two cases of erysipelas, and mentions the treatment of chronic parotid gland infection. In carbuncles he uses a 9 in. gap, 4 ma., 8 in. distance, 9 mm. of Al. and 8 min. time. The first treatment includes an area of healthy skin an inch outside the inflamed area. The later ones are confined to the center of the lesion. Incision is made as soon as any softening occurs. Small incisions seem better than large ones. A second dose is given after four days, with the same factors but half the time. A third dose is given several days later, if indicated. In all but two cases the pain was relieved, breaking down was hastened and facilitated, and healing was made less prolonged. In two cases, both on the back of the neck, in which treatment was administered early, no benefit was obtained. In all the others, benefit was prompt and striking. Two early cases of erysipelas were treated with unfiltered ray, with good results. Cases of chronic parotid gland infection in children responded well.

CHARLES D. ENFIELD, M.D.

Roentgen Ray in Treatment of Local Inflammations, Cellulitis, and Carbuncles. Fred M. Hodges. *Jour. Am. Med. Assn.*, Oct. 24, 1925, p. 1292.

A CLINICAL STUDY OF CHOLECYSTITIS WITH THE AID OF CHOLECYSTOGRAPHY¹

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PRIOR to the advent of gall-bladder visualization by the Graham-Cole-Copher method, the roentgenologic evidence of cholecystic disease was very scant, and consisted chiefly in the visualization of gallstones having sufficient calcium to be opaque. George, Kirklín and Arens have attached great significance to the visualization of the gall bladder in pathological cases by virtue of its intrinsic density or viscosity of contents, and recently Arens has noted positive gall-bladder shadows in 88 per cent of 25 operatively confirmed cases. Great stress is also laid upon the secondary indications, *i.e.*, imprints on contiguous structures, duodenal fixation and, in a lesser measure, "duodenal churning." It has been our experience that the visualization of the gall bladder without dye, while occasionally seen in gall-bladder disease, not infrequently occurs in normal cases. This also applies to the indirect signs. Carman has demonstrated definite gall-bladder shadows in cholecystectomized patients. Mills often remarked that "gall-bladder secondaries" occur so seldom when actual gall-bladder disease is present, that when they do occur their value is questionable.

The greatest value of any diagnostic measure is proportional to its power to diagnose disease in its incipency, thereby favoring early eradication. The presence of indirect signs of gall-bladder disease necessarily implies chronic inflammation, with adhesions. It is impossible for these signs to be present in an early cholecystitis in which only microscopical evidence of an interstitial or mucosal inflammation exists. In cholecystography we have a method that will give reliable information in these cases, and, as our interpretive acumen increases, should be more readily recognized. It is

only a question of time until the full potentialities are recognized and developed.

The two methods of dye administration now chiefly employed are oral and intravenous. The latter is the method of choice in cases not presenting any of the following contra-indications:

1. Obstruction of the common duct.
2. Extensive hepatic destruction.
3. Hypertension.
4. Cardiac disease, especially auricular fibrillation, or cases in which there is extensive myocardial damage.
5. Hyperthyroidism.

The diagnostic value in the oral administration is greatly decreased because of the attendant variable factors that must be given consideration before a definite opinion can be given. The amount of dye absorbed is dependent upon the dissolution of the capsules within the bowel and its absorption there. Thence it is probably carried to the liver through the portal circulation, and its entrance into, and elimination from, the gall bladder is in the manner described after intravenous injection. A routine film should be made the morning of the examination to determine the presence, degree of disintegration and position of the capsules.

The presence of inflammatory disease in the small or large bowel may delay absorption or decompose the dye, or the small intestinal and colonic motility may be too rapid to allow sufficient time for absorption. The tendency to diarrhea is frequently present after oral administration, and this is augmented by the achylia and associated diarrhea often present in cases of cholecystitis. Capsules not infrequently disintegrate in the stomach, and are either vomited or combine with hydrochloric acid to form an

¹ Read before the Radiological Society of North America, Dec., 1925, at Cleveland.



Fig. 1. Twenty-one hours after oral administration of 5 grams of sodium tetraiodophenolphthalein. Negative stone in fundus. Operatively confirmed.



Fig. 2. Eight hours after intravenous administration of 3.5 grams of sodium tetraiodophenolphthalein. Localization of positive stone shadows found during routine gastro-intestinal examination. Operatively confirmed.

insoluble acid salt. This method is to be relied upon only in cases presenting—

1. Normal shadow.
2. Presence of stones (negative or positive).
3. Topographical defects (pericholecystitis).

In early pathological cases in which the diagnosis is dependent chiefly upon the density of the shadow and the gall-bladder motility, intravenous administration must be resorted to, so that a known amount of dye enters the blood stream. A great deal of accuracy in the diagnosis of early gall-bladder disease must be sacrificed if the more simple method of oral administration is employed. Questionable findings following oral administration should always be checked with the intravenous method. In 150 oral administrations 10 per cent of the patients were nauseated and vomited; about 25 per cent had mild epigastric discomfort, lumbar pain and mild diarrhea.

The chief objections to the intravenous method held by many workers are: reactions, phlebitis, and tissue necrosis at the

point of injection due to extravasation. Our experience in 513 cases has not substantiated these claims. Since we have confined ourselves to the use of the sodium salt of tetraiodophenolphthalein entirely, there have been no reactions of importance and no local tissue changes at the point of injection. The latter assumes that the same meticulous care is employed which should be used in all intravenous administrations. Being convinced of the innocuousness of the intravenous, and the often uncontrollable factors entering into the oral method, it seems logical that the latter should be confined to those patients presenting any of the contra-indications previously cited.

The diagnosis of gall-bladder disease by cholecystography is dependent upon the following well-known principles:

1. Excretion by the liver.
2. Patency of the cystic duct.
3. Mucosal concentrating ability of the gall bladder, which is largely dependent upon the condition of the regional lymphatics.

Any variation of these conditions will be reflected immediately in the presence, ap-

pearance, density or motility shown by the gall-bladder shadow.

Failure to secure a shadow in the presence of a standard technic indicates—

1. Cystic duct occlusion.
2. Hepatic insufficiency (atrophy, cirrhosis, etc.).
3. Small, sclerotic gall bladder with obliterated lumen.
4. Cystic-lymphatic damage.
5. Failure of dye absorption (when given orally).

In the absence of any of the above conditions, the time of appearance, density and motility of the gall-bladder shadow are indirect indications of the pathologic condition of the mucosa. In time, as we learn more of the normal physiology of the gall bladder, early departure from the normal will be more readily appreciated. It is then that the full value of cholecystography will be realized.

Soon after injection the liver begins to excrete the dye, and normally at the four-hour period a well defined gall-bladder shadow is visible. At eight hours there is usually a decrease in size and an increase in density, producing the best shadow visible at any period. At twenty-four hours the size and density of the shadow are greatly reduced, often with complete disappearance. With a pathologic mucosa this sequence is not observed. There is no, or little, variation in density and the best shadow may be very faint. Of paramount importance is the variation in size throughout the series, indicating a flexible wall. Topographical defects, hour-glass contractions, dislocation of the fundus by extrinsic adhesions need no further explanation.

A study of patients with reference to habitus, according to the work of Mills, shows that bodily type influences gall-bladder motility. Often an unusually long, persistent shadow is seen in asthenics, in which there is a general visceral hypotonia; whereas a rapid motility is frequently observed in hypersthenic types. Of more

importance is the time of appearance of the best shadow, and whether there is a general delay of the cycle. Our experience has been that the very early "strawberry types" of gall bladders show a marked inhibition of the concentration phenomenon, and often only a delayed appearance of the shadow. We have become convinced through operatively confirmed cases that a gall bladder whose shadow is faint or absent until the 24-hour period, will probably show microscopic, if not gross, evidence of mucosal pathology. Sedimentation of the dye in the fundus has been frequently observed in these cases; but its significance, although not established, is probably a sluggish motility.

The emptying of the gall bladder is now generally conceded to take place via the cystic duct. Sweet stands almost alone in his contention that the anatomic relationship of the cystic duct with its valves and the ampulla make this impossible. The work of Copher, in which the common duct was ligated after the production of shadows in animals and the retention of these shadows until the death of the animals some days later, proves conclusively that the bile escapes through the cystic duct. Silverman, and later Stewart, have shown a great reduction in size of the gall-bladder shadow following magnesium sulphate administration through a duodenal tube, the same phenomenon occurring within from one to two hours following a meal rich in fats.

With the older methods, the diagnosis of stones was practically limited to those having a sufficient calcium content to be opaque. As a result, the cholesterol stone cases, which constitute a large percentage, were wanting of a positive diagnosis. Exclusive of a cystic duct occlusion with the failure to obtain a shadow, negative stones are visualized in one of two ways: (1) Production of a mottled appearance throughout the gall-bladder shadow; (2) Peripheral absorption of the dye by the stones, producing a faint calcified ring with a negative center. The latter is suggested because of

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Fig. 3. Four hours after intravenous administration of 3.5 grams of sodium tetraiodophenolphthalein. Pericholecystitis, with topographical deformity of fundus. Clinical diagnosis of duodenal ulcer. At operation, no ulcer was found, but extensive pericholecystitis, with involvement of duodenal cap.



Fig. 4. Same case as shown in Figure 3. Eight-hour film showing persistence of the deformity but a flexible gall bladder, because of great reduction in size.

a case in which no stones were visualized, and subsequently were seen as calcified rings with negative centers following cholecystography.

Clinical diagnosis of gall-bladder disease is never simple in the sense that there is a definite symptomatology, but each case presents a new differential problem. The term "right upper quadrant" disease covers a large number of possibilities, including chiefly gastric or duodenal ulcer, appendicitis with referred pain and gastric retention, spinal lesions. May I digress here a moment in stressing the last named? Just recently cholecystography was done on a female patient who had been treated three to four years for cholecystitis. A normal shadow resulted, but there was a complete obliteration of the disc between the first and second lumbar vertebræ, doubtlessly accounting for her pain. Another had her gall bladder removed, following which there was only a transitory relief of symptoms. Subsequent examination of the spine revealed a dorsal Pott's disease.

In the past, very infrequently the diagnosis of cholecystitis without demonstrable

stones has been made before there was extensive and irreparable damage to the gall bladder and liver. Graham and his co-workers have shown clinically and experimentally that cholecystitis does not exist without hepatitis, characterized clinically by an enlarged, tender liver, fever and leukocytosis, and microscopically by an extensive pericholangitis with round-cell infiltration. The infection invariably begins in the liver, carried there from some distant focus through the portal system, and travels to the gall bladder by way of the rich lymphatic supply. Even after eradication of the original distant focus, re-infection occurs from the gall bladder to the liver and a vicious circle is established. In contrast to the liver, a very vascular organ able to rid itself of infection, the gall bladder possesses very little reparative power, and remains as a constant focus. The removal of such a gall bladder does not relieve the chronic inflammatory process existing in the liver, and doubtlessly accounts for the distressing post-operative symptomatology often following, the duration of which is proportional to the chronicity of the disease and the amount of hepatic damage already present. The recovery of the liver, which has

long withstood the bombardment of infection from the gall bladder, may take from six to eight months, during which period the symptoms may be equally, if not more, distressing than before the operation. The solution is early recognition and surgical removal. Medical drainage obviously cannot remove the pathology existing in the walls of the gall bladder, but it is a valuable adjunct in the treatment of the co-existing hepatitis present. The stimulation of the sluggish liver cells to activity with the increased output of bile accounts for the relief of symptoms and the reduction in size of a tender, swollen liver.

Bassler summarizes his experience with non-surgical drainage as follows: "The less the pathology, the more the benefit." Lyon states: "Cholelithiasis remains entirely beyond the scope of this treatment." So also, it may be said, when the gall bladder and biliary ducts are chronically diseased, but little can be expected from this form of treatment.

Cholecystitis can be divided clinically into four groups:

1. Cases in which attacks of biliary colic are the prominent feature, with apparently healthy interim periods.
2. Cases in which stomach symptoms predominate, and the gall-bladder symptoms are of minor importance.
3. Cases in which the stomach and gall-bladder symptoms play an equal part.
4. Cases in which there is a general gastric indisposition over a period of years, and the gall bladder is silent.

The last group is the important one to recognize if we expect to make an early diagnosis of gall-bladder disease. Such patients go from place to place, having repeated X-ray examinations, test meals, etc., and often—unfortunately—are relegated to the "neurotic" class. Many cases of undiagnosed gastro-intestinal disorders fall in this group, and it has been our experience that a patient returning some months following an appendectomy, complaining of the same symptoms for which he original-

ly sought surgical relief, invariably has a demonstrable pathologic gall bladder. When biliary colic manifests itself the disease is well established, and the chances for immediate and permanent surgical relief are proportionately smaller.

In cholecystography we have a direct method which furnishes diagnostic evidence in the chronic but vaguely dyspeptic individuals in the beginning of the disease, at which time there may be only a pathologic-physiologic change. Of a like importance is the opportunity afforded for localizing tender points as arising from within or without the gall bladder. The dictum (no longer tenable): "We will do an exploratory operation and find out what the trouble really is," falls short in the early cases, for even with the gall bladder well exposed the surgical finger and eye often fail to detect an early cholecystitis and occasionally small stones. The rule we now follow is to remove all gall bladders showing a definitely positive cholecystogram.

Next to the bile salts, cholesterol is the most important constituent of the bile; from a pathologic standpoint it is probably the most important. Even though present in small amounts, when precipitated it crystallizes about any suitable nucleus (a clump of bacteria, desquamated epithelium, etc.) and forms stones. The concentration of cholesterol present presumably bears little relationship to its ability to crystallize, for often a high concentration is found with no evidence of crystallization and *vice versa*. The relation of the bile salts to this phenomenon may be a very important one, and we must look to the physiologic chemists for a solution. Any functional disturbance which will tend to stagnate the bile in the gall bladder probably favors cholesterol crystallization. That functional disorders do exist, especially in asthenic individuals, is certain. The general complaint of biliousness, with an icteric tint to the sclera, is often met with. The explanation is probably that of an atonic, sluggish gall bladder, which favors bile stasis and absorption

of some of its elaborated toxins, probably to be re-excreted by the already overworked liver cells. The value of the old "chologogue cathartics" and the newer duodenal drainage is evident in these cases, and they constitute the largest percentage of their clinical applicability. Preventive measures applied here will materially decrease the subsequent number of chronic gall-bladder infections.

We have performed cholecystography on 663 patients from the service of the Washington University Dispensary, Barnes and St. Luke's Hospitals. The intravenous method was used in 513, and the oral in 150 cases. Of the 131 cases that came to operation, 103 gall bladders were removed and 97 (or 94.25 per cent) were microscopically confirmed as pathologic; 28 were observed, palpated, considered as normal and not removed, making the total number of operative confirmations 125, or 96 per cent.

In conclusion, I would like to emphasize the value of cholecystography in overcoming the shortcomings of the older methods of examination, and adding to them an unprecedented accuracy, thereby favoring early recognition and surgical removal of diseased gall bladders.

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THE PRACTICAL VALUE OF THE GRAHAM-COLE METHOD IN THE DIAGNOSIS OF GALL-BLADDER DISEASE, AS COMPARED WITH THE OLDER METHOD ¹

By ARIAL W. GEORGE, M.D., BOSTON

DOCTORS Graham and Cole and their associates in giving us the sodium tetraiodophenolphthalein test, have without question made the most valuable contribution, as far as research is concerned, that we have had in the history of roentgenology.

A great majority of us have had experience by this time in the practical application of this method to the gall-bladder problem, and it would seem that this method has been universally accepted, but has it met with all the anticipated success?

We, among others, accepted this method and began its use with considerable enthusiasm,—perhaps with a greater degree of enthusiasm than others because we had borne the burden of bringing forth the older method of examination. In fact, by our persistent claims that the older method was a reliable method, we have withstood an undue share of criticism, and, at times, ridicule.

If I may be permitted for a moment, I should like to review the many phases of the older method. In the first place, this method has rested upon a firm foundation. In fact, it was built upon a fundamental law of Roentgen, in which he stated that all matter may be photographed on a photographic plate by the X-ray according to the molecular weight of the object.

It must be a true statement, notwithstanding the many controversial opinions, that the normal gall bladder is not routinely visualized. This is due to the fact that we are dealing with a very thin-walled organ, relatively small, which contains in the normal no dense material, giving us an organ that offers very little obstruction to the passage of the X-rays, in contrast with the shadow produced by the liver or the adja-

cent organs. There may be occasional exceptions to this rule, but it does not seem possible to make visible routinely the normal healthy gall bladder. As I have made this statement many times in the past, I hesitate to repeat it, but it is perfectly obvious to one whose mind is open to conviction, that the moment pathology enters the walls of the gall bladder, there is usually increased density of the wall. These changes, in turn, give the changes in the bile, which is denser than normal bile unless we have obstruction and hydrops, in which case the bile is less dense but of sufficient quantity to be made visible on the photographic film without difficulty. In addition to this, we have inspissated bile, and the typical gall-stone of varying density and size, and occasionally, tumor.

All these factors go to make up a visible gall bladder. It is beyond our comprehension that one may question these statements, and certainly we can assure you that if the exceptions are made they are made by individuals who have no interest in the problem, and whose technical qualifications are such that one would not depend a great deal upon their observations.

The secondary evidence has always been seriously questioned, but never by those who have had intimate study with this phase of the problem. Of course, the many changes which produce pressure upon the first portion of the duodenum, or the antrum of the stomach, or both, are not necessarily always the result of a pathological gall bladder. Nor does the accidental filling defect in the first portion of the duodenum always mean ulcer.

The secondary evidence, in our opinion, has proved very valuable, and we place a considerable amount of stress upon this evidence. These secondary signs are not accidental, but are based upon definite, sound

¹Read before the Radiological Society of North America, at Cleveland, Dec., 1925.

facts, and the more one becomes familiar with the study of the gall bladder, the more is one impressed with these signs. We have found, however, that those who use the fluoroscope as a primary examination in the study of the gastro-intestinal tract, as a rule, do not observe these secondary signs, or do not seek for them, and in all probability would not be able to detect them. It is only by the plate or film method, where the stomach is not disturbed by manipulation, that these secondary signs may be brought out so definitely.

The detection of gallstones by the old method depends entirely upon the technical skill of the operator. Personally, we have never had any fear of the gall-bladder problem, and not much relative to the gallstone problem, though we frankly admit that an individual stone of a cholesterin nature may not be made visible; whereas, collectively, they give an increased density to the gall bladder, interpreted as a pathological gall bladder, which may or may not contain stones. What your consultant is interested in is whether or not there is pathology in the gall bladder: the stone element is not of the utmost importance, as a rule.

The changes in the second portion of the duodenum are valuable evidence, but here again one must be familiar with the appearance of the second portion of the duodenum, which familiarity comes only after studying a large series of cases.

The filling of the ampulla of Vater is a minor sign, but one which, in our opinion, is always a signal that we may have overlooked other more definite evidence. However, with all the other signs lacking and with this filling, we always feel that we are dealing with biliary tract involvement or pancreatic disease.

The last definite evidence that we have in the study of the gall bladder is the change in the hepatic flexure or proximal portion of the transverse colon. So many times this has been the only clue to the possibly diseased gall bladder that we have come to place a great deal of stress upon this observation.

We feel that our older method of examination is an independent method. It has withstood the test of at least ten years of extreme controversy and criticism, in many instances serious, destructive criticism, and there has been no method which could be substituted for it until the introduction of the Graham-Cole method. It is certainly a great pity, and a most astounding fact, that the roentgenologists of America during all this time have not brought forth a new discovery or observation relative to this study, with the possible exception of Burnham, whose observations were confirmed by Carman. We have had, on the other hand, admirable support from men like Kirklin and Arens, at times Cole, and occasionally Case. But aside from what these men have brought forth, no advance has been made. We would be extremely egotistical if we thought for a moment that we had discovered and worked out all the phases of this problem, and that there was nothing left for others to do.

We now come to the use of the Graham-Cole method and its practical application to the study of the pathological gall bladder. Is the Graham-Cole method an independent method of examination? Can we obtain from the study of the cholecystogram as much positive evidence as we do from the older method in the interpretation of the abnormal? I should like to answer emphatically that it is not an independent method up to the present time, and that it yields only certain indirect information, with the exception of the question of gallstones, of which I will speak later.

For a moment, let us consider the administration of the salt of sodium tetraiodophenolphthalein by the oral method from four distinct phases relative to its value in diagnosis: (1) The value of the visible gall bladder by the "dye" method; (2) The absence of excretion of the "dye" in the gall bladder; (3) The motility or emptying time of the gall bladder relative to the normal or abnormal; (4) The visualization of gallstones.

(1) We were led to expect, perhaps wrongly, that the excretion of the "dye" in the gall bladder of normal size, shape and position, with a density which, with our own control, we can consider essentially 100 per cent, revealed what must be considered a normal gall bladder. We are prepared to state that this appearance of the gall bladder has no bearing upon the question of its being normal or abnormal in any way except as to size, shape and location. If this is true, we have lost a very important diagnostic sign.

(2) Relative to the absence or lack of excretion within the gall bladder in the individual case, we believe that this has a certain amount of value, but the opportunity for error because of the absence of the "dye" outweighs at the present moment its positive value, especially when the "dye" is administered orally.

(3) In going over in detail the use of this method with many who have used it more extensively than we have perhaps, they agree that the emptying time of the gall bladder is and will be the important phase of the study. We think it is fair to assume that if the physiologists are in more or less a controversial state regarding the physiology of the gall bladder, it is taking a good deal upon ourselves as roentgenologists to assume much valuable information in such a short period of time relative to the emptying time of the gall bladder by this new method. If one has had experience with this, there are many inconsistencies which arise which shake one's confidence in the question of motility as having a very serious or positive bearing upon diagnosis, at least, up to the present moment. If we take away this last phase of the study, it would not seem to us that the method is an independent one. It is a matter of take or leave what suits one's fancy in an individual case, which, on the face of it, proves that this method is not reliable and certainly not an independent method of examination.

(4) In spite of what I have said, and I hope it is the opinion of the majority that these statements are essentially true, we

have one important diagnostic value to this method, and that is in the detection of gallstones. From our experience, we have found that with this method we have an unquestioned, sound method of detecting those stones, the character of which, due to their chemical constituents, has made them invisible in the X-ray with our older method,—speaking mostly of the pure cholesterol stone which we have come to call the stone which produces the "negative" shadow. This is not a very good term, but it is a convenient one. These stones are certainly made visible by contrast, but here again we are depending upon the visibility of these stones because of one physical law, and that is that two bodies cannot occupy the same space at the same time. The bile containing the salt of sodium tetraiodophenolphthalein cannot occupy the space that is occupied by the gallstones. Naturally, we could not determine this with the older method of examination.

In conclusion, it is our hope that the Graham-Cole method will not be used as an independent method until such time as its various diagnostic phases have been proven exact. We feel that the soundest procedure to-day in the study of the gall bladder is a combination of, first, a thorough examination by the older method, and, secondly, a substantiation of the various facts obtained from the old method, by the use of the Graham-Cole method.

CONCLUSIONS

(1) The older method of examination is the only independent one at the present time.

(2) The older method may be supplemented by the Graham-Cole method:

- (a) To confirm the visible shadow of the gall bladder visualized with the older method.
- (b) To make visible by contrast stones of a cholesterol nature, which cannot be detected by the older method.

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(3) The Graham-Cole method, especially the oral administration of the salt of sodium tetraiodophenolphthalein, is not an independent method of examination.

(4) The Graham-Cole method is an independent procedure if the determination of gallstones is the only factor.

(5) It is the consensus of opinion of the pathologists that gallstones are always associated with pathology in the gall bladder.

DISCUSSION

DR. C. G. SUTHERLAND (Rochester, Minn.): It seems to me that the greatest value of cholecystography is in its use in the obscure cases; in the Mayo Clinic these make up a large proportion of cases in which the gall bladder is examined roentgenologically. The cases that can be definitely diagnosed clinically and those with contra-indications, as pointed out by Dr. Zink, are not examined roentgenologically. If operative findings of duodenal ulcer, cholecystitis with stones and appendicitis are observed frequently all in the same patient, the position of the clinician who makes the diagnosis is appreciated.

Then again, the increased interest in focal infection calls more attention to the gall bladder, which is known to be the frequent focus of infection. The patients with upper right quadrant distress, with and without definite clinical symptoms, often so puzzling to the clinician, afford an excellent series of cases to demonstrate the value of cholecystography.

With the establishment of the oral administration of the dye we abolished all other methods of roentgenologic examination of the gall bladder. We did not make a primary roentgenogram, but I agree with the speakers that it adds to the accuracy of diagnosis in some cases, if it can be carried out. There is no doubt that what we interpret at times as the faint shadow of the gall bladder is that of the pathologic gall bladder of the primary roentgenogram; that is,

the shadow is not of the dye but of the gall bladder itself, and it remains about the same throughout the series.

We have a standard gradation for the normal gall bladder: Grade 2 or 3 density at the twelfth hour, Grade 4 (maximum) density at the fifteenth hour, and diminution in volume and density, more commonly in volume, or even complete absence of the shadow, at the twentieth hour.

Dr. Graham and Dr. Zink have referred to the function of the gall bladder. Our experience has suggested this as the underlying principle of all the work. If one keeps foremost in his mind that the function of the gall bladder is to concentrate the bile, it makes it easier to interpret the shadows. A faint shadow suggests functional disturbance, and a check of our cases with the surgical findings shows that, with increasing experience, one can grade the condition of the gall bladder very accurately. The border-line case in Grade 1 is an innocent looking gall bladder in the gross, with the enlargement of the sentinel gland, spoken of by Dr. Graham, and frequently adhesions or hepatitis, suggestive of a one-time infection. This type offers considerable difficulty, but in many instances slight variations of the density are appreciable.

DR. ULLMANN (Santa Barbara, Calif.): I was very much interested to hear what Dr. Zink said about diarrhea. When we first gave the tetraiodo we obtained some commercially coated capsules, and gave them to our secretary, my assistant and myself, and two of us had diarrhea. One had vomiting and one had no gastro-intestinal symptoms, but the gall bladder did not fill, although with the same individual it filled after intravenous injection. We then adopted the method of Menees, and had no trouble filling the gall bladder, and we have had no diarrhea or intestinal symptoms whatever since we have been following that method. We are using a three hours hardening instead of four. We expose a Num-

ber 1 gelatine capsule for three hours over formalin vapor and fill it with a paste of the dye made with olive oil. Such a capsule must not be kept over three or four days or it will become too hard and will not dissolve. If the gall bladder does not visualize the first time, do not stop; give a brisk vegetable cathartic and repeat the dye the next night. If it does not visualize the second time, it is probably pathologic. I have a slide of something that has never been shown before at any meeting anywhere. This individual had vague gall-bladder symptoms and was sent in about the middle of this last November and was given the dye by mouth. I want you to notice that double shadow, denser here and thinner here, a distinct double shadow. He retained the dye over forty-eight hours and we expect the gall bladder to be empty at the twenty-four-hour examination, which is thirty-six hours from the ingestion of the dye. He retained it to the third day. At that time he was operated on. The question was, Was it a double gall bladder or an adhesion band? At operation a large gall bladder, reported normal by the surgeon, was found, with a diverticulum, as large as the gall bladder itself, arising from the anterior surface. The gall bladder appeared normal, no stones could be palpated, and, in spite of the internist, was not removed by the surgeon; he said he could go in again if symptoms appeared. A questionable appendix was removed. I was told the day I left for this meeting that the symptoms were returning and we probably would get that gall bladder for a pathological specimen. I inquired and could find no one who had heard of a double gall bladder until I got here, when I mentioned it to Dr. Nichols and found that he had one which had turned up at almost exactly the same time, just about a month ago.¹

DR. R. A. ARENS (Chicago): I want to thank Dr. George and Dr. Graham and

others for their interesting contributions, and I will confine myself to a question or two. I do not believe we ever made the claim in the old gall-bladder method that the so-called gall-bladder seat was found in every case of a pathological gall bladder. If the secondary findings, such as the gall bladder, are of no value, why do we find it at all? And secondly, why do we not see it more commonly in normal individuals whose gastro-intestinal tracts are examined? Let me ask one more question: Is there any condition in which the gall bladder would fail to fill other than in the involvement of the liver or the gall bladder itself?

DR. L. T. LEWALD (New York): I want to ask a question of Dr. Zink in regard to technic. He spoke about deformity from making prone exposures. If he took vertical exposures, would that deformity disappear?

DR. L. J. CARTER (Brandon, Man., Canada): In making this function test by means of the Graham method I have often seen on the film evidence that a gall bladder is deformed by some inflammatory process, intrinsic or extrinsic, but yet is functioning normally, in that the shadow is reduced to normal (half size) one hour after the meal. Am I right in concluding that up to a certain point a diseased gall bladder is capable of functioning normally? Am I also right in recommending to my surgeon to let such a gall bladder alone until medical treatment has been given a thorough trial?

DR. L. R. SANTE (St. Louis): I would like to ask what procedure is used in getting rid of intestinal gas? This has been very troublesome to us.

DR. GRAHAM (closing): I have already encroached on your time a good deal, but perhaps I can answer one or two of these questions. In the first place, I am not quite sure what Dr. George meant by his remarks.

¹ Radiology, March, 1926, p. 255.

I will merely state, in reiteration, that I do not wish to pose here as an advocate of this method or any other method or any single procedure in making a diagnosis of any kind. If I gave the impression that I believe that we should depend exclusively upon cholecystography in making a diagnosis of gall-bladder disease, I wish here to take back any remarks which seemed to give that impression. I happen to be one of those who believe that the clinical features particularly should never be disregarded, and also I happen to be one of those persons who insist continuously on teaching the student that we should never look upon one phase of a disease or one method of diagnosis of a disease to the exclusion of other existing methods, and particularly we should not depend upon any particular laboratory method to the exclusion of everything else.

As to the question of a diseased gall bladder functioning normally, I do not know; I do not know whether or not anybody knows. This thing, of course, is still in its infancy. From personal correspondence and communications, etc., I happen to know that there have been somewhere in the neighborhood of ten or fifteen thousand individuals examined by this method, but, after all, that is a comparatively small number, and I suspect that perhaps sometime—say, five years from now—we will be able to answer some of these questions more definitely than we can to-day. There will, of course, always be certain cases which will be puzzling. We cannot ever expect to have this method or any other method 100 per cent correct. There will, therefore, always be a certain percentage of cases, whether it will be small or whether it will be large I do not know, but a certain percentage of cases will exist which will offer difficulties in interpretation. In that respect, however, I doubt very much if the interpretation of cholecystograms is any different to-day from the interpretation of the barium meal or the bismuth meal, as it

used to be fifteen or twenty years ago; and just as progress has been made in the interpretation of examinations by opaque meals, so I think progress will be made in the interpretation of cholecystograms, as progress goes with interest.

Concerning the question of the keeping qualities of the drugs, again I cannot answer this question in a satisfactory way, perhaps. I do know this, however, that we think from our own experience that it is very desirable to have a fresh preparation. It so happens that we get fresh samples of material from each batch of the substance that the Mallinckrodt Chemical Works puts up. It is barely possible that that explains the nearly total absence of reaction which we get by the intravenous method. Since being here at this meeting and talking with others who report having had a good many rather alarming reactions by the intravenous method, I am inclined to think that possibly the freshness of the substance may have something to do with it, but I cannot answer that question adequately. I am sorry that I cannot. Of course, it is well known that organic iodine compounds have a tendency to oxidize rather quickly—spontaneously in the presence of air and sunlight; for that reason, of course, it is desirable to keep these products away from the direct sunlight, preferably in brown glass, and also away from too much air.

The question of getting rid of gas, I should prefer to have Dr. Zink or Dr. Moore answer, because it is a technical problem in roentgenology with which I am not familiar.

In closing the discussion, I wish particularly also to pay tribute to Dr. Lyon's splendid work. I touched on it only lightly in my remarks, because I was pressed for time and also because I am inclined to think, myself, that the greatest value of Dr. Lyon's work is perhaps therapeutic rather than diagnostic. Fortunately, he has a chance again to rebut this. I do think that his work has been of considerable assistance to the

surgeon, particularly in one type of case. Dr. Lyon and I have discussed this matter several times, and he has mentioned this fact particularly to me and I agree with him wholeheartedly. The type of case I refer to is this: a patient who has had his gall bladder taken out and who may, perhaps, have had some stones removed from the common duct by operation. He still has symptoms; he may still have attacks of jaundice. What is going to be done for him? There is nothing more that the surgeon can remove. There is nothing more that the surgeon can do. Further drainage of the common duct by surgery in these cases is not always a very satisfactory procedure. Dr. Lyon has attained brilliant results with some of these cases which I regard as hopeless otherwise, and I think he deserves the greatest credit for having devised a practical method for the treatment of just the sort of case which I have mentioned. I am not certain, however, that magnesium sulphate will prove ultimately to be any better than or perhaps so good as fats for this purpose, as indicated by the work of Boyden and of Whitaker.

DR. LYON (closing): It is quite appropriate in a symposium of this sort to call attention to the outstanding value of the cholecystogram method. I feel quite satisfied that most of us here to-day welcome this new method of X-ray study of gall-bladder disease as a very distinct advance that is destined to give us a greater amount of satisfaction in diagnosis. I am satisfied personally of that statement. What I am in doubt about in regard to methods of diagnosis of a single type, such as this, when set apart from the general clinical diagnosis to which, happily, Dr. Graham equally referred, is whether or not we are going to be able to "catch the gall bladder young" in disease. It will be interesting to watch the course of events for the next few years to see whether, in less expert hands than Dr. Graham's and his associates' (for men who

are doing any one particular thing that is a hobby with them, as a rule do it better than others), sufficiently accurate determinations of either the pathological or non-pathological gall bladder can be made. Surveying this subject in retrospect five or ten years from now, we will probably know in how many gall-bladder cases we have done that which we ought not to have done, and left undone that which we ought to have done.

These remarks, I am afraid, may not be as clear as I see them in my own mind. I do not think that we are now catching gall-bladder disease early enough to secure complete correction surgically in many cases. Paradoxically, I believe that in early gall-bladder disease, when recognized by the combination of clinical, laboratory, and technical methods discussed, the gall bladder can be saved and its function preserved with a good deal of ultimate benefit resulting to the patient.

I have one question on which I would like Dr. Graham to inform me, and that is whether or not, in the introduction of the dye by mouth or intravenously, any part of the dye enters the gall bladder by way of the lymphatic or blood channels within the gall-bladder wall, or does it all enter the gall bladder by way of the bile stream from the liver?

DR. GRAHAM: Practically all of the dye enters the gall bladder through the cystic duct and is brought there by the bile. A small portion of it comes through the gall-bladder wall directly. That is, we infer that this is the case, using dyes of similar chemical structure, which have stronger color and can be recognized, as, for example, the isomers. These are more strongly colored and of a similar structure, as, for example, phenol tetra chlorphthalein, or phenol tetra iodophthalein. We can see these dyes staining the gall-bladder wall, particularly the lymphatics, and some coming in through the blood vessels, but practi-

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cally all of the dye comes by way of the bile through the cystic duct.

DR. SHERWOOD MOORE (St. Louis): It has been my experience really that gas is not a very serious obstacle in interpreting cholecystograms, for the reason that, if it is colonic, the hepatic flexure or transverse colon or whatever portion of the colon it

may be, generally tends to push the gall bladder upwards. Gas in the small intestines may perhaps cause some difficulty at times, but since we have gone well into this thing, we have rarely had any question about a collection of gas overlying the gall bladder and producing confusion in interpretation.

A TECHNIC FOR INTRAVENOUS INFUSION OF SODIUM TETRAIODO- PHENOLPHTHALEIN IN CHOLECYSTOGRAPHY¹

By L. J. LIEST, M.D., Marquette University Hospital, MILWAUKEE, WISCONSIN

THE acid test of any diagnostic laboratory procedure is its justified claim to popularity. Regardless of its informative value, the clinician is justly wary of a test that involves a hazard to the existing status of his patient. The judicious physician will not risk the aggravation of a given syndrome by resorting to an untried or delicately dangerous method for further inquiry into the etiology of the case. On the other hand, if a laboratory process providing significant evidence is attended by a minimum of inconvenience to the patient, its popularity is assured.

While cholecystography has not as yet been reduced to its most desirable form, nevertheless its informative value is becoming more generally conceded by practitioners. Their real or imagined objection lies in the somewhat complicated or cumbersome technic in the matter of dye administration. Many have to be convinced that the halogen compounds involved in the Graham principle have no deleterious effect upon the physical status of the patient.

There can be no doubt that the enteric route of introduction and absorption would be the simplest, safest, and most convenient method,—if reliable. The effort to cope with a variable personal equation in the matter of the patient's co-operation, individual enteric absorptive differences, tolerance, etc., is an intricate problem, and the amount of research being done on this phase at present is a proof that a satisfactory answer to the problem has not as yet been obtained. This is unfortunate. The fulfillment of this ideal would bear an analogous relationship to cholecystography as the successful oral administration of insulin would bear to the treatment of diabetes and its allied conditions. It is hoped that results will soon be reported that will make a discussion of intravenous administration of the

halogen dye an antiquated and unnecessary thing.

It is not intended to discuss here the relative merits of oral, intravenous, or other methods. Manifestly, the infusion of the dye into the circulation eliminates many variable personal factors involved in other methods, and thus makes for greater intrinsic reliability. This is the stand taken at present by Dr. C. W. Geyer in cholecystographic work, both in his own laboratories, and as Chief of the Radiological Department, Marquette University Hospital.

The underlying principle on which the writer's technic is based is the inter-fusion of the halogen dye with physiologic sodium chloride solution, as brought out by the contributions of Geyer (1), and Tousignant (2). By incorporating this principle, and modifying it in practically only one outstanding respect, *viz.*, by providing for a more thorough diffusion of the dye with the physiologic sodium chloride solution, the writer has made 41 infusions without reaction, slough, phlebitis or other recognizable ill effects. In no case was it necessary to hospitalize the patient.

After use of various other adaptations of this basic idea, *e.g.*, the direct syringe method, the double gravity tube method, the method of mixing the two solutions in a single gravity tube with subsequent progressive dilution, as well as other processes open to trial, it has been found that the apparatus and technic described below is the safest, quickest and most convenient way of infusing sodium tetraiodophenolphthalein intravenously.

METHOD

The patient is placed in the dorsal recumbent position, the arm extending on an arm board. The arm is subjected to surgical preparation from axilla to wrist, and suitably draped to present a comfortable surgi-

¹ Received for publication January 26, 1926.

cal field to the operator. The operator, himself not yet surgically prepared, then unwraps the sterile package, containing the following articles:

1. Gravity tube with attachments (observation tube, needles, etc.), as illustrated, with rubber tubing tightly compressed at "X" by a screw cut-off.
2. Rubber tubing with hemostats to serve as a tourniquet.
3. Twenty cubic centimeter hypodermic syringe and small caliber needle.
4. Medicine glass to receive the sterile solution of dye.
5. Hemostat or Kelly forceps.

Avoiding contamination of the remaining apparatus, the gravity tube and proximal end of the rubber tubing is withdrawn and adjusted on the standard "Q". Physiologic sodium chloride solution suitable for intravenous infusion (temperature 105°) is put into the gravity tube. A 20 per cent ster-

ilized solution of sodium tetraiodophenolphthalein in distilled water is poured into the sterile medicine glass.

The exposed aseptic surfaces may be covered with sterile towels while the operator surgically prepares his hands for the actual infusion. In this, the operator elevates the tubing and connections, releases the screw cut-off "F", and allows the physiologic salt solution to entirely fill the space between the gravity cylinder "G" and the observation tube "O", after which the flow is stopped, by application of a hemostat near the observation tube. The extraneous vent "V" is filled with solution by temporarily releasing the spring cut-off "S".

After assuring himself that there is no air in the tubing and connections, the operator then draws and secures the tourniquet (sterile) by means of a hemostat, and introduces the needle into the vein in the usual manner. This accomplished, the

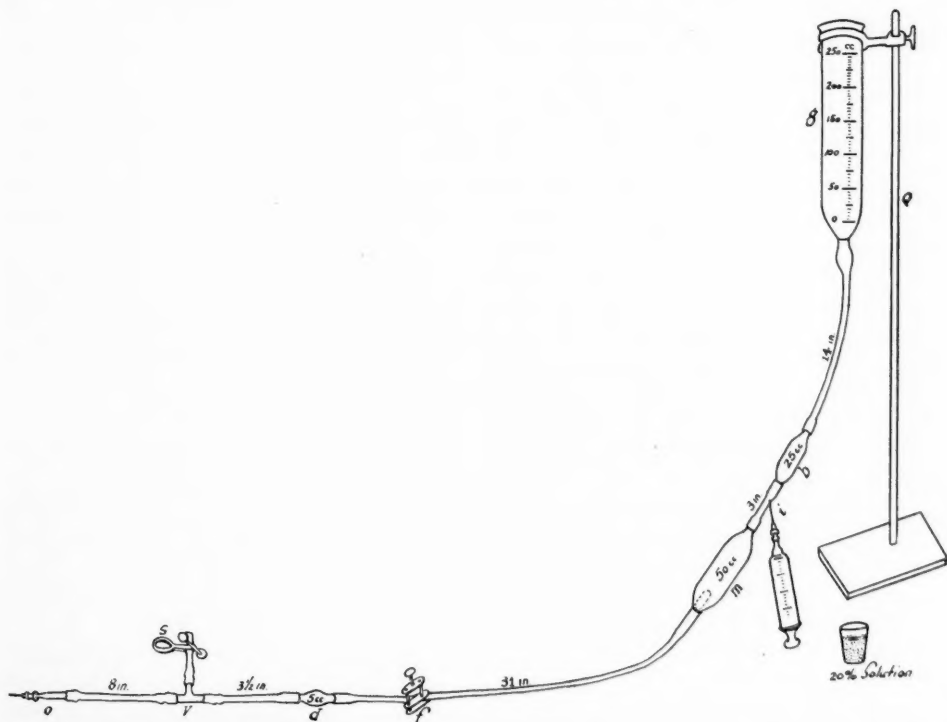


Fig. 1. Apparatus for intravenous infusion of dye for cholecystography by means of the Graham principle. The glass chambers B, C, and D are of twenty-five, fifty, and five cubic centimeters, respectively.

hemostat arresting the flow of the salt solution is removed, and the observation tube "O" (the fluid flowing freely therefrom) is fitted into the needle. Immediate release of the tourniquet is then made, and flow into the patient's vein is established.

The operator then assures himself beyond doubt that there is no escape of the solution into the surrounding tissues. This is important.

By means of the syringe and small caliber needle, 17.5 c.c. of 20 per cent solution of sodium tetraiodophenolphthalein is injected into the lumen of the rubber tubing at "I". This is done as rapidly as possible, care being taken to admit no air. The dye will diffuse about equally in the chambers "B" and "C". By manipulating the chamber "C" (capacity 50 c.c.) in a horizontal position, the contained glass pellicle "M" agitates the solution therein, and quickly brings about the necessary diffusion of the dye into the physiologic normal salt solution. As the infusion goes on, the uniformity of the mixed solutions can be observed and adjusted at the chamber "D".

With the chambers "B" and "C" placed in vertical position, as in the illustration, the diluted dye solution is displaced downwards, the position of the pellicle "M" serving to further the diffusion process. After the last trace of the dye has disappeared at the observation tube, the vein is washed with 20 or 30 c.c. of the physiologic salt solution (measurable at the gravity tube), after which the needle is withdrawn.

The average time from the introduction of the dye at "I" to its complete disappearance at "O" is three minutes.

The purpose of the vent "V" is to stop immediately the injection of the dye at any time, should occasion (reaction, accident,

etc.) arise, and at the same time to permit the "washing of the vein" with physiologic salt solution by allowing the needle to remain in place.

ADVANTAGES

The advantages of this method of procedure are as follows:

1. It reduces the danger of slough at the site of injection to practically *nil*.
2. High dilution and complete diffusion of the dye in the normal salt solution seem to prevent reactions of systemic nature.
3. It precludes air embolism.
4. While strictly an aseptic procedure, but one operator is needed.
5. There is a minimum of fluid used and of time needed (average 10 minutes).
6. An indefinite number of patients may be infused at one "set-up" of the apparatus.
7. The influx of dye may be arrested at any time, with no danger of infiltrating the soft tissues about the site of injection, or of inciting a chemical phlebitis.

CONCLUSION

The writer believes that the technic outlined above meets and minimizes the objections made by the average practitioner to a procedure which introduces foreign material into the blood-stream.

In conclusion, the writer wishes to express his gratitude to Mr. L. C. Massopust for the accompanying illustration, without which the apparatus could hardly be described with clarity.

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ROENTGENOLOGICAL EXPLORATION OF THE BRONCHIAL TUBES WITH IODIZED OIL (LIPIODOL)¹

By JACQUES FORESTIER, M.D., ancien Interne des Hôpitaux de Paris, AIX-LES-BAINS, FRANCE

THE use of a new means of contrast for radiological exploration has been, in every case, in correspondence, in some respects, with practical improvements: for example, the opaque solutions of sodium bromide have been helpful towards a better knowledge of the pathology of the kidney pelvis and ureters, and the discovery of pneumoperitoneum for radio-diagnostic purposes has increased our findings in pathology of the abdominal organs.

Four years ago we began methodically to use as an opaque fluid for radiology an iodized oil (lipiodol) which French and foreign physicians had been injecting for many years in cases where a chronic iodine treatment was to be carried out.

In fact, many physicians had noticed that this oil, being injected subcutaneously or intramuscularly, gave, in radiograms, large opaque spots, which remained visible for a long time, though no clinical symptom of the presence of the oil could be observed.

The original part of our work was to take advantage of the qualities of lipiodol—high opacity to X-rays and perfect tolerance by human tissues—and to use it as a means of contrast for the radiologic exploration of cavities which it had been impossible to explore with methods previously in use.

Our first experiments were made on the cavities of the spine, epidural and sub-arachnoid spaces, but soon after, realizing the wonderful innocuity of lipiodol, we found that it would be well tolerated by the respiratory mucous membrane and could be introduced by intra-tracheal injections. Our first attempts on animals (rabbits and guinea pigs) proved to us that lipiodol could be injected into the bronchial tubes without more danger than any ordinary oil. In January, 1922, with our friend L. Leroux, we succeeded in getting the first film

of the bronchial tubes of a living subject, a film which, for the first time, was purposely and harmlessly obtained.

Before describing the technic and results of the method, we shall say a few words about the drug itself.

LIPIODOL

Lipiodol is vegetable iodized oil, containing 40 per cent of iodine, this high percentage explaining the favorable opacity of the substance to X-rays. It is important to note that lipiodol is not a solution of iodine in vegetable oil, but a definite chemical compound in which the halogen cannot be detected by ordinary reactives. This explains why, in spite of its high concentration in iodine, lipiodol is so wonderfully tolerated in the cavities of the body; as there is no iodine free in lipiodol, this one does not produce any irritation or toxicity, as any iodine solution is expected to do.

Lipiodol is a fine, pure, transparent oil, a little darker in color and much thicker than olive oil. When it is old, or when it has been exposed to light, it becomes brownish and sometimes dim, which changes denote that some degree of decomposition has taken place, and in such condition must never be used on account of the free iodine, which may cause some irritation. The best lipiodol is that delivered in aluminum flasks; it is antiseptic itself and does not need any sterilization.

ELIMINATION

When injected into the bronchial tubes, lipiodol seems to be quickly absorbed, and the shades, which are seen immediately after injection, gradually disappear during the following days. Contrary to the other cavities of the body, the respiratory tract seems to absorb the injected lipiodol rather quickly.

¹ Read before the Radiological Society of North America, at Cleveland, December, 1925.

After an intra-tracheal injection of a high dose of lipiodol (20 c.c.), there may be, possibly, a part of the oil expectorated within a few hours. But the remaining part, which is blocked in the small tubes, is ab-

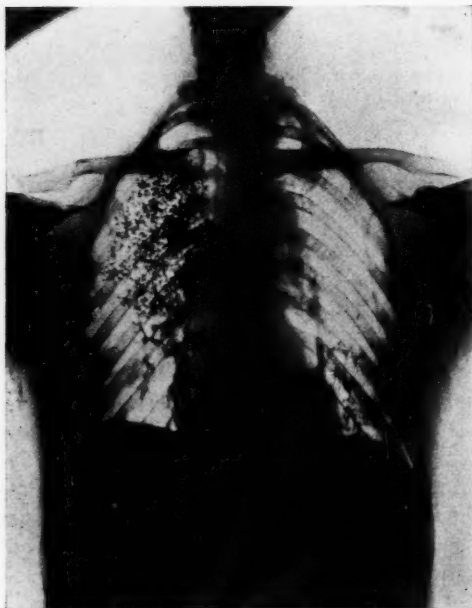


Fig. 1. Normal: visualization of small bronchi, right lung. (Lanari and Castex.)

sorbed by the mucous membrane, the oil-digesting power of which has been proved by the works of Roger and Binet (Paris). This phenomenon has been called by the authors "lipodiérèse." The successive radiograms taken daily during a fortnight show the progressive diminution of the opaque shades, and the chemical findings prove that iodized oil is regularly digested and eliminated, the last part, one-tenth or thereabouts, being visible on radiograms for several weeks. After an intra-tracheal injection of 20 c.c. of lipiodol, the daily elimination of iodine during the first fortnight is about 2 centigrams. The same dose, injected into the subarachnoid space, gives an elimination of 1 milligram under the same conditions. In case of pathologi-

cal changes, the absorption seems to be slower.

TECHNIC

At the beginning of our practice, we were, for several months, unable to obtain good radiograms, the imperfections of the usual technic of intra-tracheal injections not allowing us to inject a sufficient quantity of lipiodol with certainty. The different points which we emphasize hereafter must be carefully noticed, should the experimenter wish to succeed.

(1) There is no possibility of injecting a sufficient dose of lipiodol into the bronchial tubes for radiological exploration without a good intra-tracheal anesthesia.² For that purpose we advise the operator to inject, just before lipiodol, from 5 to 8 c.c. of a 3 per cent novocain solution in water, into the cavity of the tubes themselves. This will prevent the patient from coughing; the suppression of the coughing reflex is necessary to a good exploration. If anesthesia has not been obtained, the patient either expectorates the lipiodol, or swallows it; in the latter case, the opaque spots are seen in the stomach.

(2) All fluids injected, anesthetics and oil, should be warmed to the temperature of the body. This caution diminishes the coughing reflex and makes the lipiodol more fluid.

(3) Experience has shown that the correct dose of lipiodol varies from 20 c.c. to 40 c.c., and more, with adults, and about half that with children.

(4) Such injection renders possible the exploration of a limited part of the lungs, one or two lobes, but not more; so it is necessary to put the patient, during the injection, in such a position that the part of the lung to be explored is as low as possible. (*For the bases of lungs*, sitting position; *middle lobe*, recumbent position, either on the right or left side, according to the case; *apex*, recumbent position, the nearer shoul-

² Nevertheless, Dr. Pritchard, of Battle Creek, has been able to obtain good films of the lower lobes through laryngeal injection without anesthesia.

der being as low as possible.) In most cases it is better to explore one lung at a time.

(5) Radiograms in different positions (sitting or recumbent) and stereoscopic

lactose powder, or a swabbing with a 10 per cent solution of novocain in water. In the second part of the proceeding, intratracheal anesthesia is performed, as said before (Paragraph 1, under "Technic"),



Fig. 2. Deviation of the trachea and bronchiectasis: Trachea displaced to left side; large bronchiectatic cavities in left lower lung; cricothyroid injection of 30 c.c., erect position. (Coyon and Aimé.)



Fig. 3. Compression of lung by pleural thickening. Bronchi surrounding mass which is proved to be outside the lung. (Coyon and Aimé.)

views should be taken as soon as possible after the injection of the lipiodol. The action of the anesthetic does not last more than twenty minutes, and then coughing appears. All radiograms taken after several coughing spells have lost their accuracy.

TRANSGLOTTIC INJECTION

This is the ordinary method of intratracheal injection, but our experiments, carried out under radiologic control, showed us, in 1922, that the technics usually described in papers or text-books were not reliable.

The injection must be performed with a long curved catheter, the end of which must be pushed down through the glottis into the trachea itself with the help of Clar's mirror. To allow this movement, the mucous membrane of the pharynx and larynx, and the vocal cords must have received previously a good dose of anesthetic. We use either a pulverization of 10 per cent novocain in

and 20 c.c. of lipiodol is injected with a long syringe, which generally allows a little larger quantity of fluid. The injection may be performed with the patient either seated or recumbent.

This technic is the safest; with it, no accident is to be feared. It requires some skill in the injection, but may be done by any physician after training, just like lumbar puncture. When the injection has not been performed quite right, the only accidental consequence is the introduction of the lipiodol into the stomach, instead of into the lung. It may be repeated as often as necessary.

SUBGLOTTIC INJECTION

This is surely an easier way, but it is not so safe, because it requires a puncture of the intercrithyroid membrane. For this purpose, we use a needle, 5 centimeters long, the curvature of which is that of the tracheotomy cannula; its diameter is twelveths of a millimeter. After local anesthesia of the skin, the curved needle is stuck directly into the trachea, just in the middle line of the neck. First, from 4 to 8 c.c. of the anesthetic solution of novocain is injected into the trachea, causing a rather strong coughing reflex, but two minutes later, through the needle, the lipiodol may be injected slowly with a 10 c.c. or 20 c.c. syringe with a screw piston. The patient is required to breathe slowly and deeply and to refrain from swallowing, speaking, or coughing. We generally join the needle with the syringe by means of a thick-walled India rubber tube, the flexibility of which prevents the operator from pulling or pushing, and so avoids any wound in the trachea.

When the anesthesia and the injection have been correctly performed, the radiologist has about 10 to 15 minutes to take his films before the patient begins to cough. Several films may be easily taken during such a length of time.

OTHER TECHNIQS

Lipiodol may be injected into the bronchial tree by two other ways:

(1) Through the laryngoscope, a gum or metallic catheter being introduced into the trachea, under local anesthesia.

(2) Through the bronchoscope, again with a catheter. This last procedure allows an accurate repartition of lipiodol.

RADIOLOGIC TECHNIC

It sometimes may be expedient to witness the progress of the lipiodol in the tubes under the screen, but generally radiography is the best technic to be used. Rapid exposures, taken in different positions and inci-

dences, localize the eventual pathologic changes. Stereoscopy has proved useful.

After the injection, the auscultation of the breast shows diffuse wet bronchi in the part of the lung where lipiodol has pene-

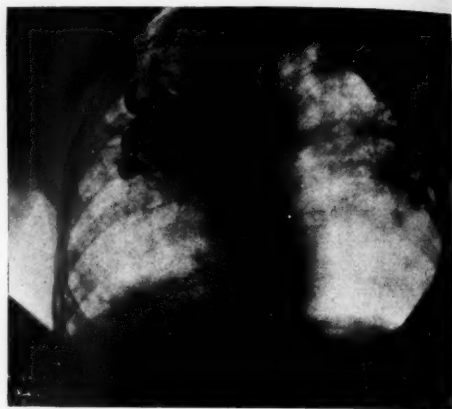


Fig. 4. Tuberculous cavity in left apex: Draining bronchus is visible. (Sergent and Cottenot.)

trated. These may be heard for two or three weeks, and the patient must be warned of the fact, in case of an eventual clinical examination. Likewise, to avoid any subsequent radiologic mistakes, the physician must tell the patient that the opaque shadows of the oil may remain in the chest for several weeks.

RESULTS

(A. Normal subjects)

We have already said that the lipiodol method gives very good dark radiographs of the bronchial tubes in but a limited part of the lung. During the injection and immediately after, the trachea and the two main bronchial tubes may be easily outlined, if the patient has been injected while recumbent. When the respiratory movements have pumped the lipiodol into the tubes of smaller size, the last ramifications in the lobules are accurately demonstrated (Fig. 1). The bronchial tubes in the bases of the lungs are, of course, easier to inject than those in the apex, but that is a question of technic.

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Fig. 5. Multiple lung abscesses: in the course of anaërobic infection of right lung. Two square cavities are demonstrated by lipiodol; a large cavity with horizontal fluid level contains some lipiodol at bottom; injection of 40 c.c., erect position. (Coyon and Aimé.)



Fig. 6. Bronchiectasis, ampullar type: Numerous cavities in left lower lobe; typical picture. (Coyon and Aimé.)

(B. Pathologic cases)

Indications for the exploration: (a) When a deviation, stricture or abnormality of the trachea is suspected; (b) On patients, adults or children, with a long pulmonary story and chronic expectoration, in which the diagnosis between phthisis and bronchiectasis is difficult; (c) After a vomica, which means that a cavity is in communication with the bronchi; (d) In cases of thoracic fistulæ, the origin of which is to be ascertained; (e) Every time that clinical, laboratory, or radiologic explorations do not give a clear pulmonary diagnosis.

CHARACTERISTIC PICTURES

(1) Deviations of the trachea, about which numerous mistakes are made, are easily diagnosed from the apex cavities for which they are mistaken on ordinary radiograms (Fig. 2).

(2) The presence of a pulmonary tumor, involving a lobe, does not allow the lipiodol to enter the corresponding bronchi; the absence of penetration into a lobe which has been put in good position during the injection is an aid to the diagnosis of severe pathologic changes.

(3) In case of lung compression by a thoracic or pleural growth, the outline of the latter is sharply given by the stoppage of the lipiodol in the lobules and bronchi at the periphery of the growth.

(4) The cavities of the lung may be exactly localized, and their shapes and volumes clearly delineated, provided they are in communication with the bronchial tubes. The irregular pictures of tuberculous cavities, and those of lung abscesses in pulmonary gangrene (Forestier, Coyon) are quite characteristic, even when all clinical and radiologic findings have failed to give any certainty (Figs. 3 and 4).

(5) But the most important benefit of the method has been a direct diagnosis of bronchiectasis. In many cases when there were only suspicions, the proof has been furnished of the existence of the disease. In other cases, it has permitted the correction of a wrong diagnosis, showing that the bronchial tubes were of normal size. All kinds of bronchiectases may be observed on the films: small ones, cylindrical type, on the main or small bronchi; larger ampullar bronchiectases, which are appended to a few bronchi; large and numerous am-

pullar cavities so near one another that they look like one large cavity if the patient is recumbent, but when the plate has been taken in a sitting position, every cavity is obvious, with an horizontal level which re-

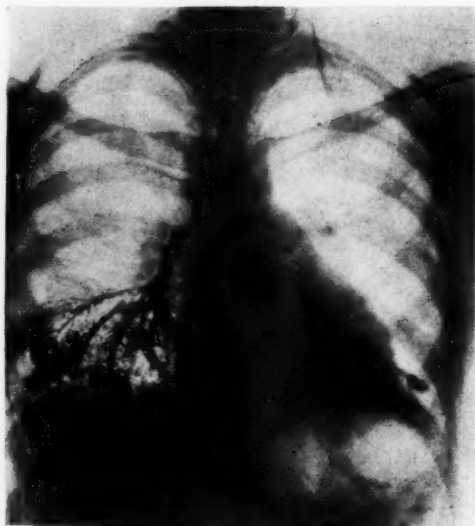


Fig. 7. Bronchiectasis of terminal bronchi, "glove's finger" type: pathologic changes demonstrated in spite of heart shadow. (Sergent and Cottenot.)

sembles a sigmoid valve (Fig. 6). When the bronchiectasis involves the terminal bronchi, the picture looks like the fingers of a glove (Fig. 5).

(6) After therapeutic pneumothorax the exploration with lipiodol may give two kinds of information:

(a) In case of pleural adhesion, to show whether it consists of a plain membrane, or contains a fragment of the lung. This fact is most important when the adhesion has to be cauterized according to the method of Jacobaeus, of Stockholm. If the radiogram shows some bronchial tube in the adhesion, cauterization is not indicated, because broncho-pleural fistula would ensue.

(b) When bronchiectases or tuberculous cavities have been treated by therapeutic pneumothorax, the method is a control of the lung collapse. It has been proved by this method that the way to the pulmonary

lobules is still open in such conditions (Giraud).

ACCIDENTS

The injection of lipiodol in the bronchial tubes is quite a harmless operation. Out of over 300 injections, we have not had any severe accident, and all authors having a like experience of the method, have said the same.

Sometimes there is a little transitory iodism after the injection of large doses. This comes from the fact that the patient has swallowed an important part of the lipiodol, and the absorption in the digestive tract is very quick. Since we have been telling our patients to expectorate the oil when coughing, this accident has happened very seldom.

Some investigators have noticed a rise in temperature of one degree. This seems to happen more often with consumptive patients.

With the intercricothyroid method there may be a little expectoration of blood coming from the tracheal wound, but it is never really important. After an accidental injection into the cellular tissue of the neck, we have observed in one case an edema of the epiglottis.

At the site of the needle puncture, a small superficial abscess may occur, and, in a few cases, the injection has been followed by a transitory subcutaneous emphysema.

CONTRA-INDICATIONS

(1) The first one is hemoptysis. It is safer to wait a few days after the end of it, to make a lipiodol injection.

(2) The injection is not to be attempted with febrile, tuberculous patients.

(3) In case of pulmonary gangrene or any anaërobic infection of the respiratory tract, it is advisable to avoid any cricothyroid puncture, and, if a lipiodol injection is wanted, to perform it according to the natural, transglottic, method.

THERAPEUTIC ACTION

Though our first studies concerned a mere diagnostic standpoint, we, like others, have been impressed by the good results of the intra-bronchial injections of lipiodol on patients with much expectoration (bronchiectasis, lung cavities). In many cases we have seen a decrease of the quantity of sputum for several weeks or months as well in bronchiectasis as in lung cavities. It is to be hoped that a certain therapeutic result may be produced by this harmless and powerful local iodine treatment.

CONCLUSIONS

The radiologic exploration after intra-tracheal injection of lipiodol has given us the possibility of getting direct films of normal and pathologic bronchial tubes and of lung cavities. It has been especially helpful for the diagnosis of bronchiectasis.

An experience of four years has proved that it is a quite harmless exploration which, in some cases, may have some therapeutic value.

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DISCUSSION

DR. FORESTIER (closing): I have not myself practised antrum injections, but I have seen them made. They were made in normal cases in the beginning and also in cases where there was a fistula. The laryngologists have observed no accidents resulting from the injection, and in certain cases they thought it was of some therapeutic value, especially, of course, in chronic cases—not in acute ones.

DR. H. J. ULLMANN (Santa Barbara, Calif.): I should like to ask Dr. Forestier if there is any subjective symptom from the sinus injection.

DR. FORESTIER: No pain—no, no more than any other.

DR. ULLMANN: I have heard there was pain.

RADIO-ACTIVE SUBSTANCES AND THEIR THERAPEUTIC USES AND APPLICATIONS

RADIUM TREATMENT OF RECTAL CARCINOMA¹

By JOSEPH MUIR, M.D., NEW YORK

IN my consideration of cancer of the uterus I have already noted that anatomically this organ—especially that portion of it most frequently affected by malignancy, the cervix uteri—lends itself peculiarly to radium therapy. This is because the nature of its structure permits the applicators containing the radium to be placed advantageously in direct contact with the malignant growth, with relatively little danger of irradiating the adjacent non-malignant tissues. In addition to these mechanical advantages, the mucosa of the vaginal canal is not excessively radio-sensitive.

In the treatment of rectal cancer, on the contrary, we are faced with precisely opposite conditions. Though the lesion is usually situated within reach of the surgeon's exploring finger, from the point of view of the radiologist it is highly inaccessible. The mucous lining of the rectum is peculiarly susceptible to the effects of the radium rays, and it is only by bringing the center of radio-activity directly in contact with the neoplasm that injury to the surrounding healthy tissue can be avoided. A brief consideration of the form and structure of the organ in question will quickly convince anyone that this is bound to be a decidedly difficult procedure.

In order to appreciate the value of radium in the treatment of rectal cancer, and to understand why it is still regarded by many eminent therapists as unsuitable for malignancy located in the lower part of the gastro-intestinal tract, it will be well to review the whole subject of rectal carcinoma, to consider whether the results obtained by surgery are conspicuously better than the supposedly poor ones following the use of radium, and to take up in some detail the

anatomic and pathologic aspects of this particular lesion which are prone to render its treatment by any means especially difficult and unsatisfactory.

Unfortunately, rectal cancer is a relatively common malignant growth, its incidence being reckoned at about 5 per cent of all carcinomatous lesions. Like other cancers, it is most likely to affect middle aged and elderly individuals, and also appears to occur somewhat more frequently in men than in women.

For the purposes of our discussion, the rectum may be arbitrarily divided into three sections—as indicated by Miles: (1) The anal canal—that portion embraced by the external and internal sphincters, and by the horizontal fibers of the levatores ani; (2) the ampulla, consisting of a lower part below the peritoneal reflection, and an upper part covered by peritoneum in front and at the sides only, and (3) the rectosigmoid or upper portion, joining the terminal part of the third piece of the sacrum about four and one-half or five inches above the mucocutaneous junction of the anus.

It has been noted by McVay that there is a marked divergence of opinion as to what part of the rectum is the most common location for the initial lesion of carcinoma. He remarked that while the English surgeon, Cole, gave the favorite site as the anterior and lateral walls, Rawlings believed the posterior wall to be most often affected, while Oehler declared such neoplasms were seen quite as frequently on the anterior wall as upon the posterior aspect. Edwards asserted that about 80 per cent of the growths occur 5 to 7 cm. from the anus, and Gant, in 100 cases, found 50 per cent in the ampulla and 15 per cent in the upper rectum and sigmoid. W. J. Mayo's experience in a like number of cases was that 63 per cent

¹ A complete bibliography will be appended to the last paper in Dr. Muir's series on Rectal Carcinoma.

occurred in the rectosigmoid, 30 per cent in the rectum, and 7 per cent in the anal canal. Mummery, the English proctologist, states in his text-book that "by far the commonest situation is unfortunately the worst from the point of view of treatment—namely, high up in the rectum and involving the peritoneal cavity." He cites the views of some of his colleagues who have disagreed with him, and concludes that these differences of opinion are actually due to variation in the stage at which the growth was examined. "It is well known that growths in the rectum as they increase in size and tend to produce obstruction, gradually get pushed down, until eventually they become partially invaginated into the bowel below, so that ultimately they occupy a much lower position in the bowel than that in which they first originated. Since the introduction of the sigmoidoscope, which has enabled us to diagnose growths which are out of reach of the forefinger, it has been possible to detect growths in the bowel at a much earlier stage than was possible when we had to depend upon a digital examination alone, and we now know that by far the commonest starting point for growths in the rectum is the junction of the rectum and sigmoid—that is to say, just above the peritoneal reflection."

Of the *cause* of cancer of the rectum, we know no more than of that of other malignant lesions. The evidence is strongly in favor of chronic irritation as a predisposing factor in the production of cancer wherever located, and in regard to the rectum it is easy to point out a number of influences which make this part of the body peculiarly subject to such irritation. Mummery, Gant, and other text-book writers emphasize the danger of untreated benign neoplasms as likely to become malignant later on. Gant names inflammatory or ulcerative catarrhal or infectious colo-proctitis, constipation complicated by fecal impaction, hemorrhoids, fissure, chancroids, secondary leucic and tubercular lesions, or the continual irritation incident to catharsis, localized medication, introduction of enema tubes, X-ray

burns, and scar tissue generally, as being conditions likely to provide a soil fertile for the growth of malignant tissue.

Be the exciting cause what it may, once established, a rectal growth pursues a course which has now been observed clinically often enough to make it possible to forecast it with a fair degree of accuracy. Adenocarcinoma is the type of neoplasm almost invariably encountered in the rectum. The growth arises from the glands of Lieberkuhn, the cells, after taking on their malignant characteristics, penetrating to the submucosa and invading the outer coat of circular muscle fiber. Harrison Cripps says that such growths are of two easily differentiated varieties: one showing a tendency to spread as a thin layer between the mucous and muscular coats, while the other extends more uniformly in all directions, so that it produces a more distinct tumor formation. Cole tells us that in the beginning the initial carcinomatous focus will be covered by unbroken epithelium, surface ulceration taking place later. This surface extension may follow either of two courses: the undergrowth in the submucosa and muscular layers may undermine the glandular epithelium, and induce necrosis by cutting off its blood supply, which eventually results in the exposure of the subjacent carcinoma as the base of the surface ulcer. Again, as the process spreads, the mucosa may be gradually undermined and exposed to infiltration directly from below, so that the carcinomatous process shortly makes its appearance on the surface. This, he considers the more common sequence.

In any event, when first discovered the clinical appearance of any type of growth is very similar. Of Cole's twenty specimens, eighteen presented "a typical carcinomatous ulcer," though "in one there was a tendency to mass formation, while one exhibited a diffuse colloid infiltration." The edges of the ulcers were irregularly rolled and everted, their long axes being transverse and tending to advance around the lumen of the bowel rather than to progress either up or down. Spreading thus

from the anterior or lateral wall, the ulcerative process gradually entirely encircled the tube. Thus there is usually more of the growth invisible beneath the surface than is to be perceived on inspection or palpation, a circumstance of great importance to the radium therapist. In early cases, the resulting tumor will be freely movable upon the underlying muscularis, but as the process of infiltration advances the growth becomes gradually more and more firmly fixed, until it is wholly adherent to the rectal wall. "As the growth encompasses more and more of the circumference, the wall becomes correspondingly rigid, and marked narrowing of the lumen results."

Of equal importance to the radium therapist is the extension which may have taken place through the lymph nodes. It is the opinion of such an experienced surgeon as W. J. Mayo that more rectal cancers are rendered inoperable through local extension than because of the development of metastases. Infiltration and permeation of the lymphatics increase the extent of the malignant area quite as much as direct growth. Miles has vividly delineated how this spread occurs both without and within the rectal walls. Within, the cancer cells extend along the submucosal lymphatics, tending "to permeate by radial intramuscular channels to a deeper lymphatic plexus where the area of spread may be of considerable extent, and from this they are conveyed by connecting channels running extra-murally to the lymph glands." This author believes it to be quite impossible to judge how early in the course of the development of a rectal carcinoma such lymphatic extension may take place, for in a very wide surgical experience he has several times seen growths which, though clinically in an early stage, had already "given rise to widespread lymphatic involvement and to deposits of cancer in the pelvic mesocolon and pelvic peritoneum at a distance of several inches from the site of primary growth." This spread is visible only in the event of laparotomy having been performed, the ordinary methods of rectal examination never revealing

it, for even in comparatively small and early growths, the lymphatic channels may be invaded to such an extent that practically all the tissues in the lymphatic areas connecting the original lesion with the glands should properly be regarded as malignant.

These areas may be considered as divided into three zones—"the zones of downward, lateral and upward spread. There is free intercommunication between the lymphatics of the rectal wall and those contained in the ischio-rectal fat, perianal skin and the external sphincter. Involvement of this area does occur even when the primary growth is situated in the upper part of the rectum. The lateral zone comprises the levatores ani, retro-rectal lymph glands, internal iliac glands, the prostate, the base of the bladder, and, in the female, the cervix uteri and the base of the broad ligament, with Poirier's gland. Situated between the upper surface of the levators and the pelvic diaphragmatic fascia there is an extensive lymphatic plexus which freely communicates with the intramural lymphatics."

The zone of upward spread is the most important of all, for in this are included the pelvic peritoneal floor and the entire extent of its mesocolon, together with the glands in the colon's outer coat and those at the bifurcation of the left common iliac, all of which are likely to be affected early in the extension process. It was noted by McVay that early glandular involvement affects so small a part of the gland that its presence can be detected only by microscopic examination. His investigations showed that growths which present only slight lymphatic involvement tend to spread by direct extension, and are slow-growing. In his opinion, systematic microscopic examination of all the regional lymph nodes should be undertaken in order to give a reasonably accurate forecast of what outcome may be expected. Unfortunately, the dangers attendant upon biopsy render this a decidedly hazardous means of arriving at an opinion, and it is obvious that few, or none, of the cases coming under the care of

the radium therapist, will have undergone any such scrutiny.

As regards metastasis, most authorities appear to agree that this is not so common, nor does it occur so early, when the primary growth is in the rectum, as when the original focus is elsewhere located. Pennington went over a large number of reports to get statistics on this subject and found that, among others, Symmers, of Bellevue Hospital, New York City, had reported fifteen out of twenty-eight cases of rectal carcinoma examined postmortem as being without any evidence of metastasis; while of Murphy's series, 22.2 per cent of rectal cancers had proved fatal without metastasis taking place. In his own experience about one-third of the autopsies showed that the regional lymph nodes had been affected. When it does occur, metastasis appears to be most frequently to the liver and to the retroperitoneal lymph nodes, the hepatic involvement probably becoming possible by

the passage of carcinomatous emboli into the portal circulation.

The radium therapist should always demand a careful roentgenographic examination of the entire body before undertaking to treat a case of rectal carcinoma, for the existence of metastasis in most instances places the patient beyond any but palliative aid, and to proceed with treatment under these circumstances will merely discredit both the therapist himself and the element with which he is working. The careful selection of cases is the imperative duty of everyone who undertakes to cure a rectal carcinoma, and while treatment should not be refused to even the most advanced and hopeless cases, it should be given on the clear understanding that its only aim is palliation, and the amelioration of some of the most distressing terminal phenomena with which the last days of these sufferers are frequently burdened.

(To be continued)

Pulmonary tuberculosis.—The writer points out that before the introduction of serial radiologic examinations of the chest it was generally held that pulmonary tuberculous deposits undergoing healing were replaced by fibrous or calcified structures. It has now been shown that actual absorption of lesions may occur. He gives five case histories, illustrated by radiographs, to show that massive exudative tuberculous deposits have been absorbed, and he adds that some of the illustrations appear to indicate that caseous residues were replaced by apparently healthy lung tissue. In some cases the absorption of lesions was associated with a complete disappearance of râles; in other cases râles remained, possibly owing to a bronchiolectasis. He emphasizes the point that rest in pulmonary

tuberculosis should be prolonged for many months after the temperature and pulse have become normal and the sputum has disappeared. He found by his radiologic examinations that tuberculous deposits generally started to clear up after six months of rest, but were not completely absorbed until after two or three years of rest. He believes that recurrence in pulmonary tuberculosis is often due to the fact that prolonged and complete rest has not been continuous, nor of sufficient duration.

Recovery in Pulmonary Tuberculosis. G. B. Webb. *Jour. Am. Med. Assn.*, Sept. 19, 1925, p. 867. (Reprinted by permission from *Brit. Med. Jour.*, Oct. 24, 1925, p. 57 of *Epitome of Current Medical Literature.*)

FURTHER STUDIES ON PHYSICAL STANDARDS OF PROTECTION AGAINST ROENTGEN-RAY DANGERS ¹

By A. MUTSCHELLER, Ph.D., NEW YORK

MY first paper on this subject² is a report of physical data from which the intensity and dose of radiation transmitted through the usually employed protection devices can be calculated under various conditions of operating diagnostic, fluoroscopic and therapeutic equipments. In that paper also is calculated the average "tolerance dose" to which every month operators under normal conditions of good protection are exposed. This tolerance dose, therefore, is the dose which, according to our present notions, can be considered permissible and safe. But in that paper only the effects of primary or direct rays are dealt with, and the influence of scattered or secondary radiation protection has been reserved for this second paper on standards of protection.

So as not to underestimate the dangers of the scattered radiation there is evidently required a special type of ionization chamber and electroscope, designed specifically for estimating the total radiation quantity which might potentially be capable of causing injury. This instrument should not only be much more sensitive than the usual type but it should also be constructed of such material as does not appreciably absorb any of the long wave length or low penetrating rays, for these, as is well known, are the most dangerous components of any radiation in so far as possible injurious effects are concerned. The instrument that was employed for the measurements reported in this paper, and which by test was found to fulfill the required conditions, is illustrated in Figure 1. It consists of an electroscope of the usual type which is placed on top of a formica cylinder whose inner surface is coated with graphite to render it conductive. In its center there is

a graphite rod supported on amber pins. Through these precautions the leakage of the instrument is reduced to so small an amount that ordinarily it is negligible. The calibration of the instrument was made by

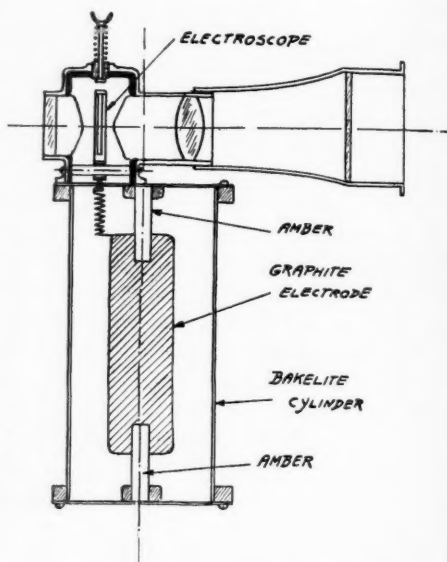


Fig. 1. The ionization chamber and electroscope employed for detecting and measuring secondary radiations. The outside wall consists of thin bakelite graphited on its inner side. The central electrode is graphite supported on amber, the same as the leaf which is housed within a lead-lined bead. The lens system serves to project an image of the leaf upon the ground glass.

measuring its electrostatic capacity and its voltage sensitivity in the usual manner, and, finally, it was compared with other carefully calibrated instruments. The basis of its calibration is 1,300 R as the erythema unit. Another type of ionization chamber was also used for some measurements. It is illustrated in Figure 2, and although considerably more sensitive than the first instrument described, it does not seem to offer any additional advantages for the reason that it is also more susceptible to electro-

¹ Read at the Eleventh Annual Meeting, Radiological Society of North America, at Cleveland, December, 1925.

² Am. Jour. Roentgenol. and Rad. Ther., Jan., 1925, XIII, 65.

static disturbances, caused by high tension lines, spark or corona discharges, etc.

After it has been determined, either by test or by calculation, what dose is delivered to the patient directly from the target of

radiation which he receives either from the part of the patient's body or from nearby objects exposed to the rays. The following measurements, therefore, were made to determine the influence of secondary radiation upon the tolerance dose.

A number of objects or materials were exposed at an angle of 45° to the rays from a uniform potential machine operating with a voltage that produces a minimum wave length of 0.065 Ångström units. These rays were filtered through 0.58 mm. of copper. The area exposed at a distance of 24 inches from the target was 978 square cms. The ionization chamber was carefully shielded against direct rays and was placed at a distance of 23 inches from the center of the irradiated area and at an angle of 90° to the direction of the primary beam, as is shown in Figure 3.

When the area covered by the beam is about 1,000 square cms. of exposed material then there is obtained, at right angles to the direction of the beam, when one erythema dose of radiation is given, the following doses of secondary radiation:

Material	Percentage of the incident dose	Factor F for 1 sq. cm. at 50 cms.
Iron	5.4	17.75
Brass	6.2	20.50
Copper	6.4	21.25
Lead	7.2	23.75
Aluminum	7.7	25.50
Bakelite	7.7	25.50
Birch wood	10.4	34.25

the tube, it is quite evident that it should also be known what the dose is that reaches the patient in addition thereto as secondary radiation from nearby objects which are also exposed to the rays, while the treatment is being given. What the extent of the biological effects or the influence upon the patient of such a "general bath" of secondary radiation may be is a clinical question, and shall not be dealt with in this paper. But from the standpoint of the question of protection for the operator it is of the greatest importance to know exactly the dose of

Exactly the same ratios of secondary to primary radiation doses were found, irrespective of whether the radiation was filtered or unfiltered.

To bring out more prominently the effects of secondary radiation upon the safe "tolerance dose," as defined in my former paper, we can now calculate the dose of secondary radiation that is produced under the same conditions for which the tolerance dose has been calculated. When, then, we

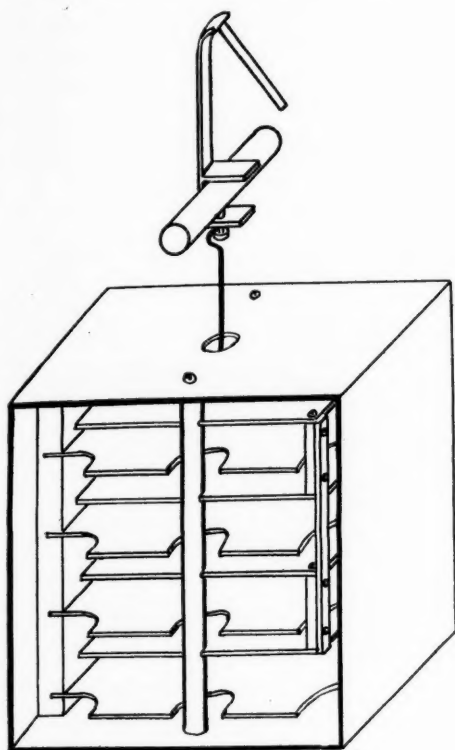


Fig. 2. Shows a multicellular cube-shaped ionization chamber. The insulated plates are supported on amber but the same electroscopical shown in Figure 1 was employed with it.

assume the tube to be completely surrounded with a drum lined with lead 5.6 cm. thick and being operated with 4 milliamperes at about 200 kilovolts for 10 hours daily, then at 50 cms. distance and in one

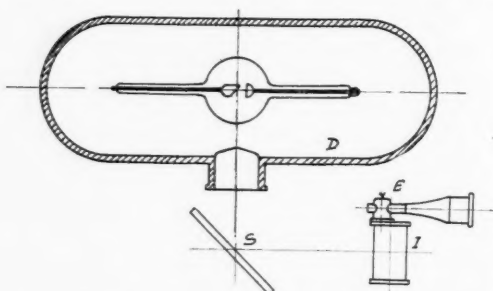


Fig. 3. Shows arrangement of the lead-lined protection cylinder *D*, the scattering material *S*, and the ionization chamber *I*, for the experimental determinations.

month's time the patient would receive about 106 erythema doses and through the leaded drum at a distance of 10 feet the operator would receive about 1/100 of an erythema dose. Moreover, if we now also assume that on the patient an area of about 1,000 sq. cms. is exposed, then from this area we would in addition obtain $106 \times 3.86 \div 100$, or a little over 4 erythema doses.

The results from these measurements indicate, therefore, that the secondary radiation from objects exposed to the short wave length primary rays are very much more potent than the direct rays transmitted through correctly leaded protective shields, and the operator must be separately protected against such secondary radiation.

Quite obviously, the area exposed has also a large influence upon the intensity of the secondary radiation produced, for it is well known that the production of secondary radiation is a function of the volume exposed.

The following results were obtained by exposing various areas of bakelite exactly under the previously described conditions. At a distance of 23 inches from the scatter-

ing material, at an angle of 90° from the direction of the primary rays (see Fig. 3), the intensities measured are for:

Area Sq. cms.	Percentage of the inci- dent dose	Ratio between	
		Area	Secondary radiation
15.8	.2	1	1
53.0	.6	3	3
106.0	1.2	6	6
213.0	2.3	12	11.5
978.0	10.0	54	50

These data, in the first place, reveal the fact that for practical and clinical purposes the intensity of secondary radiation produced depends and varies as the area exposed on the patient or on other scattering material. Hence, doubling the area doubles the intensity of the secondary radiation, and quadrupling the exposed area makes the intensity four times as great.

In the second place, however, it would seem to be interesting at this moment to calculate the intensity of secondary radiation when the tube is not completely surrounded with protective material and when, therefore, the ceiling, the walls and nearby apparatus of the therapy room are all taking part in the scattering of the rays. Of course, it may be somewhat difficult to estimate exactly the area exposed, but if we make the conservative estimate that about one-fifteenth part of a room of size $6 \times 8 \times 10$ feet, or about 24 square feet, are exposed, there would be delivered at an assumed average distance of 5 feet, in one month's time, 114 erythema doses.³ Assuming then that the walls are lead-lined, then the secondary radiation near the patient would sum up to:

$$\begin{aligned} &\text{Fraction of incident dose per 1,000 sq.} \\ &\text{cms.} \times \text{area} \div \text{by square of distance,} \\ &\text{or, } 7.2 \times 22.3 \times \frac{23^2}{60^2} = 23.6\% \text{ E,} \end{aligned}$$

³ Vide loc. cit., p. 68.

as often as one erythema dose is given to the patient, or for 114 erythema doses there are produced within the patient's body $114 \times 23.6\%$, or 27 additional doses of secondary radiation.

Again, if the walls of the therapy room should be lined with hardwood, then the secondary radiation returning from them would be 34.1 per cent, and in one month's time the patient would then receive 38.87 erythema doses of secondary rays.

At this moment it might be interesting to make a comparison between the doses of secondary radiations that are produced in the therapy room, in one case, when the tube is located within a lead-lined housing, or, in the other case, when it is merely held in one of the usual lead glass bowls. In the table below are, therefore, placed side by side the results of our previous findings, which make the contrast more evident.

In a way, it is rather surprising that no biological studies have ever been made to determine the difference between exposing a patient either to the direct effect of the primary rays and the negligible fraction of the secondary radiation produced within his body only, or also to a dose of from 24 to 34 per cent of the primary dose over the entire body in addition to the primary radiation dose given. It would seem that these differences should be investigated, not only with the object in mind of alleviating the severity of the after-effects but also to determine the effects of such secondary doses

upon the blood and possibly upon the blood-forming organs. In view of the importance of the protection question, it is hoped that the pointing out of the method of calculation will be an inducement to someone to continue and settle definitely the dispute on the rational method of tube housing for deep therapy.

The method of calculation thus far applied seems rather complicated and leading easily to confusion when applied. But the factors which enter into the making up of the final total dose to which the patient is exposed can easily be arranged in a simple formula, such as the following:

$$\frac{E_p \times S \times F \times 50^2}{d^2} = E_s$$

or simplified,

$$\frac{E_p \times S \times F}{d^2} = E_s$$

where E_p is the primary erythema doses administered, E_s the erythema doses of secondary radiation formed, and S the area of the exposed surface in square centimeters. F is a factor characteristic of the material from which scattering is produced, and which is taken from the table. These factors are calculated from the measured secondary radiation intensities for the distance of 50 cms. and 1 sq. cm. This formula is, therefore, similar, and its derivation is sim-

Primary radiation delivered to patients in one month's time	Tube housed	Exposed to primary rays	Secondary radiation produced around patients	Protection required for operator if 10 feet from patient
114 erythema doses	In lead-lined drum of .56 cms. thickness	1,000 sq. cms. of patient's skin and tissue	3 to 4 erythema doses	0.30 cms. of lead
	In lead glass bowl	24 sq. ft. of room interior and apparatus	27 erythema doses	0.48 cms. of lead

ilar to the formula for the direct primary radiation, given in my first paper on protection.⁴

If it is desirable to calculate the protection material required to cover the patient to a sufficient degree, then the method outlined in the earlier paper can also be directly followed.

Inasmuch as the preceding calculations are somewhat of a speculative nature, it would naturally be interesting to compare as a check some direct experimental measurements of the radiation intensities in therapy rooms. The measurements made cover as many good installations as could be reached within the last few months and were made with the instrument described in the introduction. In some instances, the measurements show good agreement with the calculated results, but in a few cases they differ from the calculated results, the discrepancies being in all cases traceable back to radiation leakage of one kind or another. On the whole, however, the measurements corroborate the deductions and calculations, so that it seems justifiable to present the theory and formulæ for general use.

Installations Group 1. The tube is housed in a lead-covered couch upon which the patient lies, exposed to an opening of 20×20 cms. There is found, at a distance of 10 feet from the patient, that there is a radiation intensity of 0.085 per cent of the incident intensity, which in one month of time would amount to 9 erythema doses, but, as calculation shows, includes about 4 per cent, or about one-half, as coming from the ceiling of the room.

Installations Group 2. The tube is housed in a lead-lined drum 0.56 cms. in thickness and the patient lies on a wooden table. The floor beneath the table is concrete and the area exposed is about 1,000 sq. cms. At a distance of 10 feet from the patient there is measured a radiation intensity of 0.055 per cent, which in one month's time

would accumulate to about 6 erythema doses. Therefore, about 30 per cent of the radiation was reflected from the concrete floor.

Installations Group 3. The same equipment described under Group 2 was changed by placing a lead plate under the table top on which the patient lay, so that the concrete floor was not irradiated. The intensity measured at 10 feet distant was then 0.046 per cent, which accumulated within one month to 4 erythema doses, which is the intensity calculated on the assumption that there is secondary radiation only from the surface exposed on the patient.

Installations Group 4. This group includes those equipments in which the tube is supported in an open lead glass bowl. The radiation intensity near the patient (of course, without exposing the ionization chamber to primary radiation) was measured to be 26 per cent of the incident dose, which in one month's time would accumulate to about 30 erythema doses, which the patient would receive in addition to the primary dose. At the distance of 10 feet from the patient, where the operator is located, there was measured an intensity of 15.5 per cent, which would accumulate in one month to about 17 erythema doses, against which the operator must be protected.

SUMMARY

In this paper on protection against secondary radiation there is described and reported—

1. An ionization chamber for measuring total primary and secondary radiation intensities.

2. The percentage radiation intensity from various scattering materials and the number of erythema doses which sum up at a distance of 10 feet from the patient in one month's time, when the tube is protected in a correctly designed lead drum.

3. The effects of various areas exposed on the secondary radiation intensities and

⁴ *Loc. cit.*, p. 66.

the number of radiation doses to which the patient is exposed if the tube is housed in a lead glass bowl.

4. Various types of installations were compared with respect to secondary radiation doses, to which, on the one hand, the patient is exposed, and against which, on the other hand, the operator must be protected.

5. Simple formula is developed for cal-

culating secondary radiation intensities with the hope that an inducement will be hereby given to someone to do the necessary biological experimental work to decide the effects upon the patient, either of complete protection against secondary radiation or of the possible harmful effects of a diffused general irradiation of the entire body with secondary rays.

Rickets.—The writer, who remarks that it is particularly difficult to determine the success of treatment in rickets, selected as a criterion the occurrence of calcification in the long bones, which were examined at fortnightly intervals by skiagrams of the extremities. He examined thirty children, whose ages ranged from twelve to twenty months. Each method was tried on three or four patients, the duration of the trial being twenty-eight days. During this period the most successful treatment—namely, the mercury vapor quartz lamp—always produced calcification. The Hanau or Jesionek lamp, employed daily until marked pigmentation was obtained, invariably caused definite calcification after twenty-eight applications, and in half the cases at the end of a fortnight, the results corresponding with those obtained by Hultschinsky and most of the other observers. As soon as any other method proved inefficacious, irradiation with the mercury vapor quartz lamp was applied to determine whether the case would respond at all to treatment. Mechanical stimulation of the

skin by the combination of mustard plasters, massage, and gymnastics failed to cause calcification within twenty-eight days. Normal sunlight applied by exposure ranging from ten minutes to an hour proved efficacious, though it was not so satisfactory as the mercury vapor quartz lamp. Injection of blood which had been irradiated by the quartz lamp had no effect in the four cases in which it was tried, although twenty-eight intramuscular injections in doses of 5 c.c. were given.

Rosenbaum comes to the conclusion that at present the mercury vapor quartz lamp is the only cure for rickets which is liable to be effective in a relatively short time, apart from natural sunlight, the therapeutic and prophylactic properties of which are limited by climatic conditions.

Treatment of Rickets. S. Rosenbaum. Monatsschr. f. Kinderheilk., Sept., 1925, p. 547. (Reprinted by permission from Brit. Med. Jour., Oct. 24, 1925, p. 59 of Epitome of Current Medical Literature.)

ERYTHEMA DOSES IN ABSOLUTE UNITS¹

By WILLIAM H. MEYER, M.D., and OTTO GLASSER, Ph.D., X-ray Department, New York Post-graduate Medical School and Hospital

OF all the various methods of determining the quantity and quality of the roentgen rays, the consensus of opinion to date would suggest that ionization in air has proven the most accurate. Many propositions have been made to choose a dosage unit based upon ionization in air. The first to propose such a unit, the so-called electrostatic unit, was the French physician Villard (1), as early as 1908. He defined as a quantimetric unit, that quantity of radiation that produces one electrostatic unit per cubic centimeter of air under normal conditions of pressure and temperature. From a scientific point of view the best definition of this unit was given by Behnken (2), in 1924, basing it on the valuable work of Friedrich (3), Duane (4) and Holthusen (5), as well as on his own investigations. Friedrich had already improved upon Villard's definition in 1918, Duane publishing along similar lines at about the same time.

Behnken defines the unit as follows: The absolute unit of the roentgen-ray dose is obtained from that roentgen-ray energy, which, by fully utilizing the secondary electrons and by avoiding secondary radiation from the wall of the chamber, produces in one cubic centimeter of atmospheric air under normal conditions such a degree of conductivity that the quantity of electricity measured by saturation current equals one electrostatic unit. This definition corresponds practically to that of the older *e*-unit but avoids its original inaccuracies. Behnken, however, retains the name of "Roentgen," as originally suggested by Solomon (6), to designate this unit.

Solomon bases his roentgen unit on the ionization produced in a small graphite ionization chamber by a given amount of radium under specified conditions. In 1922 he defined his Roentgen-unit as follows:

The absolute unit of the roentgen-ray dose is that intensity of the radiation which produces the same amount of ionization per second as one gram of radium element at a distance of 2 cm. from the ionization chamber (both in the same axis) and filtered with $\frac{1}{2}$ mm. of platinum. The quantity of radiation is given by the radiation intensity expressed in *R* per second, multiplied by the time of application.

Since experimentally the definition of the Solomon *R*-unit is not free from objection and since it depends at any rate in its applicability to a large degree upon the special type of indicating instruments used, the *e*-unit must be given the preference for general use. But even if Solomon's method takes second place as far as the definition of an absolute dosage unit is concerned, it has distinct practical advantages in the fact that radium is employed to control the constancy of a dosimeter and check its calibration. This advantage might well be combined with the *e*-unit method to help the practitioner in the constant control of his instrument.

If we follow Behnken's suggestion and apply the name "Roentgen-unit" exclusively to the new definition of the *e*-unit, we will not forget to credit Solomon as first suggesting the name of the discoverer of the roentgen rays for an ionization unit.

The *R*-unit, as defined by Behnken, is the one employed in our research and referred to throughout this article.

The problem in which the practical radiologist is mostly interested is, above all, the connection of roentgen-ray quantities measured in *R*-units with the biological effect, observed, for instance, on the skin. Such determinations have been made by a number of investigators (Friedrich (3), Duane (4), Bachem (7), Glasser (8), Beets and Arens (9), Fricke and Glasser (10), Grebe and Martius (11) and others).

¹Read before the Radiological Society of North America, at Cleveland, December, 1925.

Until very recently there was a sharp discrepancy between the biological doses reported in *R*-units. These were evidently due to different causes:

1. Variation in the degree of reaction as well as the personal equation in determining these reactions; also possible variations in radiosensitivity of different individuals or deliberate short dosage.

2. Inaccurate theoretical and experimental definition of the *R*-unit.

3. The number of *R*-units for the same biological effect depends to a great extent upon the quality of radiation employed and to a lesser degree upon the relative intensities used.

should be mentioned that a number of radiologists consider their erythema doses as being much lower (Schinz (13), 500 *R*; Pfahler (14), 690 to 820 *R*; Holmes and Dresser (15), 1,080 *R*). Since these differences most likely are due to such causes as in Paragraph 1, given above, a discussion of the methods pursued and results obtained to correlate the biological reaction with the physical measurements, as made in our department, may be acceptable.

During the past ten years the Roentgen Therapy Department of the New York Postgraduate Medical School and Hospital, under the direction of Dr. William H. Meyer, has been working along certain definite and

TABLE I

Name	Old erythema dose for fairly hard rays		New erythema dose for fairly hard rays		Remarks
	Year	<i>R</i> -units	Year	<i>R</i> -units	
Friedrich (3)	1918	170	1925	(1,350)	Determined by own experiment on Friedrich Iontoquantimeter.
Duane (4)	1922	1,700	1925	1,200	Personal communication from March, 1925.
Bachem (7)	1923	1,800	Same		
Glasser (8)	1924	1,350	"		
Beets and Arens (9)	1924	2,500	"		
Fricke and Glasser (10)	1924	1,400	"		
Behnken (12)			1925	1,200	
Grebe and Martius (11)			1925	1,200	

4. Dosage measurements in air must of necessity vary with those made directly on the skin of the patient, backscattering not being recorded in the former. (The latter, being the logical one, is used throughout this article.)

Due to one or the other of these causes the first reported erythema doses in *e*-, respectively, *R*-units from different observers revealed a fluctuation of from 170 *e*-units (Friedrich) up to approximately 2,500 units (Beets), a range of variation of almost 1,500 per cent. A recent more critical review reveals a greater unity of opinion. A comparison of the newer findings, contrasted with the older of several investigators, is given in Table I.

With the possible exception of Beets' value of 2,500 *R*-units for an erythema, the table shows that with hard rays about 1,300 *R*-units represent an erythema dose. It

constant lines of dose measurement, which makes it possible to check back quite accurately on the quality and quantity of radiation employed.

The methods of dose estimation have been supplemented by numerous tests with ionization, making it possible to quite accurately translate the previous technic into *e* or *R* units. A review of this method is now in preparation for publication; suffice it here to say that the $d^{1/2}$ value layer formed the basis of determining the quality, and that, besides the various intensity measurements employed, a definite skin reaction was sought in all cases where such procedure was permissible or justifiable.

The experimental definition of the *R*-unit, as used in these experiments, was gained by means of a large air ionization chamber, calibrated in our laboratory. Furthermore, a Wulf ionometer with small graphite cham-

ber was used, which was calibrated in R-units by Behnken in the German Physikalisch-Technische Reichsanstalt. The R-units laid down by both methods were found to be identical. Methods of measuring with these instruments have frequently been presented; they shall, therefore, not be described here.

It will be correctly surmised that with but few exceptions the method of treatment has been rather intensive, with the use of comparatively full, not fractional, dosage.

Our experience would tend to justify the conclusion that a given measured dose will result in a definite erythema in fully 75 per cent of the cases; that this unit dose would never result in a serious reaction on any part of the body (in any case where the skin was comparatively normal and had not been subject to previous radiation or irritation), this reaction, of course, coming on within two weeks after application. In the balance of the cases where the skin did not appear to show a reaction, a demarkation of the exposed area could be obtained by means of hot compresses. We have noted a faint erythema on the more sensitive parts of the body in certain cases with $4/5$ of the quantity of radiation above noted as the unit dose. We have also found it possible to administer $1\frac{1}{4}$ times the unit dose and still avoid vesiculation, whereas $1\frac{1}{2}$ times the erythema dose has occasionally resulted in small vesicles or so weakened the skin as

visible reaction is noted with from $1/2$ to $3/5$ of the erythema dose. This does not mean that no biological effect has occurred, since two half-doses administered within a week's interval usually reveals a mild reaction, thereby proving an otherwise invisible effect and cumulation.

The total range of an erythema reaction appears to extend over about 100 per cent from minimum to maximum; that is, from a faint blush up to a point just short of vesiculation or denudation.

It would be most logical to select as a unit dose the minimal dose with which a reaction occurs in the maximum number of individuals: with hard rays, this occurs in the vicinity of 1,300 R-units. With this as a basis, Table II illustrates the number of R-units for the various reactions described.

The foregoing work was done with three different types of machines; in addition to this, using 1,300 R-units as an erythema dose standard with hard rays, 70 X-ray machines, including ten different types, were standardized, and the range of erythema reactions obtained were all within the range above described.

Table III, showing the various time factors and percentage variations under similar conditions of operation, is here appended.

The opinion has been expressed (Friedrich (3), Stenstroem (16), Glasser (8), Solomon (17) and others) that the number of R-units might indicate a given reaction

TABLE II
ERYTHEMA REACTION ²

	$3/5$ (60%)	$4/5$ (80%)	1 (100%)	$1\frac{1}{4}$ (125%)	$1\frac{1}{2}$ (150%)
Fractional dose	None	Mild	Unit	Strong	Very strong
Reaction					
R-units for hard rays ($d\frac{1}{2}$ approx. 13 mm. Al.) ..	780	1,040	1,300	1,625	1,950

to result in small denuded areas when subjected to irritation.

As far as fractions of the unit erythema dose are concerned, faint reactions are occasionally noted when from $3/4$ to $4/5$ the erythema dose is applied. Practically no

over the whole range of wave lengths, but scattered reports in the literature and our own findings reveal that this is not the case.

² In all the reactions referred to in the article the total range of focal distance was 30 to 50 cm. and the sizes of the areas treated were from 15×15 to 20×20 cm.

Mech. R. is transformer apparatus with mechanical attachment, disc, needle, etc.).
Mech. R. Co. is the same plus condenser attachment.
Ind. Co. is induction coil apparatus.
Ken. is high tension direct current machine of the filament valve type.

Difference
Shortest time Ken.
Difference
80%

54 min.

TABLE III

No.	Name	Place	Type of Machine	R.	Erythema dose		Type of Machine	R.	Erythema dose	
					1,300 R-units, 200 K.V., 4 ma., 1/2 mm. Cu. + 1 mm. F.S.D., 50 cm. F.S.D., Large area	450 R-units, 100 K.V., 4 ma., No filter, 30 cm. F.S.D., Large area			1,300 R-units, 200 K.V., 4 ma., 1/2 mm. Cu. + 1 mm. F.S.D., 50 cm. F.S.D., Large area	450 R-units, 100 K.V., 4 ma., No filter, 30 cm. F.S.D., Large area
1	Bec	New York	Mech.	R. 3	97 min. <	7 min.			76 min.	8 min. <
2	Ben	New York	"	"	72	36 L.			83	
3	Bet	New York	"	"	54	37 M.			58	
4	Bu	New York	"	7	54	38 M.			78	
5	C.	Washington	Mech.	R. 1	95	39 M.			75	
6	Cl	Cleveland	"	"	73	40 M.			59	
7	Cl	Cleveland	"	"	73	41 M.			55	
8	Cl	Cleveland	"	"	77	42 M.			67	<
9	Co	New York	"	"	82	43 M.			67	<
10	Co	New York	"	"	82	44 M.			67	<
11	D	New York	"	"	76	45 M.			76	
12	D	Toledo	"	"	79	46 Mo			95	
13	E	Cleveland	"	"	73	47 O			95	
14	F	Detroit	"	"	75	48 P			80	
15	G	Providence	"	"	96	49 P			72	
16	G	Paterson	"	"	82	50 P			88	
17	G	Cincinnati	"	"	82	51 P			80	
18	G	New York	"	"	73	52 P			72	
19	G	New York	"	"	73	53 R			73	
20	G	Pittsburgh	"	"	80	54 R			73	
21	H	Detroit	"	"	77	55 R			75	
22	H	Detroit	"	"	79	56 S			75	
23	H	New York	"	"	70	57 S			78	
24	H	Youngstown	Ind.	Co. 4	76	58 S			78	
25	H	Salem	Mech.	R. 2	81	59 S			78	
26	H	Cleveland	"	"	80	60 St			72	
27	H	Cleveland	"	"	80	61 S			72	
28	I	Newark	"	"	80	62 S			78	
29	K	Baltimore	"	"	90	63 W			86	
30	K	Brooklyn	"	"	75	64 W			72	
31	Ke	Baltimore	"	"	82	65 W			72	
32	L	Cleveland	"	"	73	66 W			74	
33	L	New York	"	"	70	67 Wa			74	
34	L	Far Rockaway	"	"	70	68 W			75	
35	L	Far Rockaway	"	"	70	69 W			75	
						70 W				

Note:

Nos. 1 to 10 in the third column are ten different types of machines.
 Mech. R. is transformer apparatus with mechanical rectifier (cross arm, disc, needle, etc.).
 Mech. R. Co. is the same plus condenser attachment.
 Ind. Co. is induction coil apparatus.
 Ken. is high tension direct current machine of the filament valve type.

Time Factor:

1,300 R-units

Longest time Mech. R. 97 min.

Shortest time Mech. R. 67 min.

Difference 45%

Shortest time Ken. 54 min.

Difference 80%

It is evident that the number of *R*-units necessary for an erythema reaction diminishes with the longer wave lengths or softer quality of rays.

To arrive at quantitative conclusions on this question, we carried out a number of erythema tests in a similar manner as described above, but extended our investigations to softer rays. Though a number of cases have been observed, this report is only a preliminary one, since results based on a large series of observations are necessary before drawing final conclusions.

The result of these investigations is as follows: *The roentgen-ray quantities, measured in R-units, which are necessary to produce the same biological reaction on the human skin, vary markedly with the radiation quality used. The number of R-units per erythema decreases with increasing*

have attempted to establish a means of determining the number of *R*-units necessary to produce relatively uniform skin reaction with varying ray qualities, and believe that this curve will prove of practical utility to the roentgen therapist.

There is another factor of minor consideration, namely, that ionization current and skin effect do not vary in the same proportion with the relative intensities. Large intensities (high milliamperage or short focal distances) produce a somewhat greater skin effect than the respective ionization current, or number of *R*-units, would indicate.

The erythema doses in *R*-units referred to in this article are given in one sitting. Fractional dosage would introduce a new factor, namely, the cumulative effect of the rays, resulting in an increase in the num-

TABLE IV

Voltage in K.V.	Filter in mm.	Half value layer in mm. Aluminum	Erythema dose in <i>R</i> -units	Quality coefficient
75	—	1.0	—	—
100	—	1.5	450	0.32
130	—	2.0	500	0.36
130	4 Al.	4.5	700	0.50
130	¼ Cu. 1 Al.	8.0	900	0.64
130	½ Cu. 1 Al.	11.0	1100	0.79
200	¾ Cu. 1 Al.	150	1300	0.93
For harder rays up to gamma rays of radium			1400	1.00

wave lengths. Table IV illustrates the results of our investigations.

From these data we can infer a quality factor for the *R*-unit given in the last column. If we designate the quality factor for the hardest rays as 1.0, then we have noted a diminution to as low as 0.32 for quite soft rays. The quality factors indicate the numbers with which the ionization units in air for hard rays will have to be multiplied when using softer rays in order to determine the number of *R*-units to produce relatively the same skin effect. Restated in another way, the number of *R*-units increases with increase of the half value layer, *i.e.*, with increased hardening of the rays.

A graphic representation of the results is given in Figure 1. By this curve we

ber of *R*-units, when divided dosage is employed.

CONCLUSIONS

1. The *R*-unit, as defined by Behnken, is restated and forms the basis of our physical dose measurement.
2. The physical unit is correlated with the skin reaction.
3. For uniformity of biological reaction, our findings suggest a considerable variation in the number of *R*-units, mainly dependent upon the ray quality.
4. Based upon a series of experiments, we have drawn a curve correlating the erythema dose in *R*-units with various ray qualities.

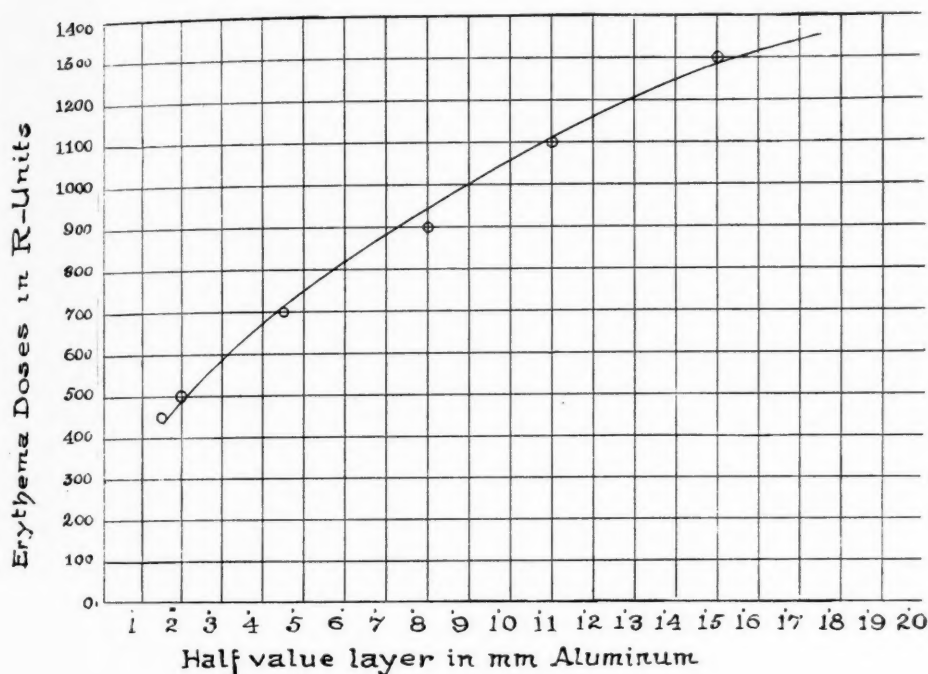


Fig. 1.

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DISCUSSION

DR. OTTO GLASSER (New York): I differ with Dr. Desjardins' statement made yesterday; I do not think it is possible to deliver two or three erythema doses in one sitting without getting a profound reaction.

DR. ROBERT A. ARENS (Chicago): Regarding the variation in transformer and tube output that Dr. Glasser spoke about and which was just mentioned by the previous speaker, I might call to mind an experiment we conducted in Chicago. The paper was published in RADIOLOGY (Oct., 1924, p. 293) some time ago, in which we went over some ten or twelve tubes, checked them as to output, using all the usual factors, voltage, milliamperage, etc. We made a check of new tubes against old tubes on the same machine. We found that new tubes vary as little as 2 per cent with about the same voltage factors, etc., but tubes that had been run for varying periods of time

showed a discrepancy of as high as 37 per cent in output as compared to the new tubes. The time that a tube had been run was no criterion as to the decrease in output. For instance, one tube that had been run 350 hours, disclosed a decrease in output over the new tube of something like 17 or 18 per cent. A tube that had been run only 75 hours showed the greatest decrease, 37 per cent. I believe that merely standardizing transformers as to output is not going to solve our problem. We should measure the ray at the point at which we are using it, and measure the tube output at that point, measuring the wave length and quantity.

Now, the difference between the electrostatic unit, which we reported some years ago before this Society, and the *R*-unit that Dr. Glasser has spoken about, at first seems rather great. He quotes a difference of about 50 per cent, that is, 1,300 *R*-units and about 2,500 *e*-units, including back scattering, for an erythema dose. Now it strikes me that, in spite of that apparent difference, we are coming closer and closer together. It would be well if, in making physical measurements, physicists would agree on a method and a type of apparatus, similar ionization chambers, etc., and then conduct a series of experiments along that line. I believe if that were done, we would find very little discrepancy in the dosages as given by these various physicists. If we could get the physicists to agree on this sort of thing, it would help solve our problem.

DR. H. J. ULLMANN (Santa Barbara, Calif.): I think this paper by Dr. Glasser is extremely valuable as a beginning, to correlate the physical standards we have all been struggling with to the biological standards we all want. Dr. Chamberlain and Dr. Newell calibrated a number of machines in California a year or two ago in *e*-units, and they reported that my machine delivered approximately 1,300 *e* for the dose which I called a 100 per cent dose. This was done with one millimeter of copper as a filter, using a Solomon ionometer.

I found that I should use two-thirds of this dose with a half-millimeter of copper. I was using ninety minutes with one; that would be sixty minutes with a half, and I noticed that the table shows sixty-seven minutes; so you can see that the American 100 per cent dose, or the average 100 per cent dose, is not very far off from this erythema dose that is in process of being standardized. It shows that we are all fumbling around pretty close to the same thing. I would like to ask Dr. Glasser how often he thinks a dose, this 1,300 *e* dose, can be given and at what intervals he would consider it safe. The complete factors for this dose of 1,300 *e*, as determined by Dr. Newell, were: F.S.D. = 50 cm., K.V.P. 200, milliamperes 5, time 90 minutes, filter Cu. 1 mm. + Al. 1 mm.

DR. GLASSER (closing): It is interesting to notice that the largest part of the discussion deals only with the short remark which we made in connection with the results of the calibration of eighty different X-ray transformers. I can see, however, the practical value of these results for the roentgenologist. To answer Dr. Goosmann's question first, the calibration data recorded in the slide have been secured for different tubes. We had to calibrate these machines for the conditions the Doctor wanted to work with, *i.e.*, with his machine, his tube, his filters, etc. There is no question that a part of the variation in the output shown is due to differences in the tubes. Measurements to show these differences have often been published, and Dr. Arens gave to-day a very good summary of his observations in this line.

Dr. Goosmann stated further that he regards his erythema dose as being much higher than what the physicist calls an erythema. I do not think that there is such a thing as a physicist's erythema dose. The physicist has to depend upon the judgment of the roentgenotherapist as far as the actual dose to produce an erythema is concerned. He only can record and reproduce

such a dose in physical radiation units. We tried, as shown in our paper, to select from the large range of skin reactions following the application of measured doses that dose as a unit, where the maximum number of cases showed a minimal skin effect. We found this dose to correspond to 1,300 *R*-units, when using relatively hard rays.

I did not know that Dr. Ullmann and other roentgenologists in the West had calibrated their transformers in *e*-units by Dr. Chamberlain. It is certainly gratifying to know that they also, working with entire independence, found their erythema doses to be 1,300 *e*-units when using hard rays; this corresponds very well with our results of the last few years. It contradicts, on the other hand, Dr. Arens' statement that the physicists do not agree upon the method of measuring the *e*-unit. They agree pretty well; now they all use large, experimentally well defined air chambers. The result is a good agreement of the measured data, as shown in Table 1 (with the exception of Beets and Arens' value). A little over a year ago I was afraid that for a number of years there might be a difference between the *e*-unit that we used in this country and the *R*-unit as defined by Behnken. For that reason I secured a Wolf Ionometer from Germany, standardized in Behnken's *R*-units. The comparison of both units showed them to be identical. I do not understand in this connection the remarks Dr. Arens made about the differences between *e*- and *R*-units. One exception has to be made, that is, in regard to the Friedrich *e*-unit. According to Friedrich's statement at the last International Radiological Congress in London, his original *e*-unit is experimentally not well defined. Friedrich is about to report his new experiments concerning this question.

I am not able to answer Dr. Ullmann's question concerning the safe time limit of repeating an erythema dose, since this is more a medical question than a physical one.

The main point we wanted to bring out in the paper has not been brought up in the

discussion. It concerns the difference in the number of *R*-units for the production of a certain skin reaction when using different qualities of rays. We feel that for the practical roentgenologist it is important to know that, while 1,300 units are necessary to produce a certain skin reaction when using hard rays, 500 units are sufficient to produce the same effect when using soft rays. Of course, in all these experiments the limit of such dosage methods must be borne in mind. If we concentrate a large variation of reactions observed on the skins of many patients, down to one figure, for instance, to 1,300 *R*-units, we must expect that when applying this same dose of 1,300 units to a large number of patients we will find again the same large variation of skin reactions.

DR. A. MUTSHELLER (closing remarks): To the question of different units and of varying tube output, I would just like to add, that these problems have been quite live ones for many years. There are observations and experiments which have led to the conclusion that there are two causes responsible for a diminution of a normal tube output. One is that the tube becomes gassy; the other is that its inner wall becomes coated with a layer of tungsten. If the tube becomes gassy, its output is hopelessly diminished and there is no remedy except to attempt to clean up the gasses, but that may, especially in bad cases, not work at all. If, on the other hand, there is a layer of tungsten on its inner walls, then the difference in the output is only apparent and is measurable only without a filter, because then the tungsten layer acts as a filter. If, however, you place the normal copper filter in the path of the rays, you will find that the difference from a normal output diminishes materially and comes down to 2 or 3 per cent, unless the blackening is excessive. If a tube, measured without a filter, shows a great diminution of output, the diminu-

tion may not be nearly so large if the measurement is made through the proper filter.

Now in regard to radiation measurements to be made with standardized methods and instruments, etc.; well, that is just a thing that physicists do not do, and, in fact, that seems to prevent them from falling into pit-holes. If a measurement or a result can

be obtained by different methods, with different apparatus and under different conditions, then it can be depended on; in fact, if a standardized apparatus were put on the market and everybody used it, it might occur that everybody would make the same blunder and the blunder would be perpetuated in that way.

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SOME X-RAY FINDINGS IN LOBAR PNEUMONIA ¹

By WEBSTER W. BELDEN, M.D., Director of Department of Roentgenology, New York Hospital,
NEW YORK CITY

WE shall attempt in this paper, by careful study of a number of pneumonia cases from the records of our hospital, to determine whether or not the type of pneumococcus causing the infection of the lung will cast a particular shadow in the radiographs of the chest. To explain this it would perhaps be best to say, Will a Type I pneumococcus affect the lower lobe more frequently than the upper? Will Type IV affect the upper lobes more frequently than any other type? Will the right lung be more frequently affected by a certain type of pneumococcus than the left, and *vice versa*?

Osler defines lobar pneumonia as an acute infectious disease caused by the pneumococcus of Fraenkel, characterized by inflammation of the lungs, a toxemia of varying intensity, and a fever which usually terminates by crisis. Secondary infective processes are common.

Pneumonia has been known for generations. In fact, it is mentioned by Hippocrates and the old Greek physicians. Our modern knowledge dates from Laennec (1819). It is a well known fact that it is one of the most widespread and fatal of all acute diseases.

In January, 1881, Pasteur discovered the organism of pneumonia, known as the *micrococcus lanceolatus*, *pneumococcus* or *diplococcus pneumoniae*. The organism is a somewhat elliptical lance-shaped coccus, usually occurring in pairs, hence the term *diplococcus*. About the organism in the sputum a capsule can always be demonstrated. Its kinship to *streptococcus pyogenes* is regarded by many as very close. The pneumococcus is present in the mouths of the larger portion of healthy individuals, various observers giving 80 to 90 per cent positive results.

Further investigation of the pneumococcus has proven it to belong to four different groups, or types, which are classed as Types I, II, III, IV. They differ in virulence and Type IV, which is responsible for only one-fifth of the cases, is the commonest form found in the mouths of healthy individuals. A fifth well-marked strain has been determined in South Africa, by Lister. In passing, it may be well to simply mention the morbid anatomy and clinical course which is well known by us all.

Since the time of Laennec, pathologists have recognized three stages in the inflamed lung: engorgement, red hepatization and gray hepatization.

In the stage of engorgement the lung tissue is deep red in color, firmer to the touch, more solid, and, on dissection, blood and serum ooze readily from the air cells. It still crepitates, though not as distinctly as healthy lung, and when small pieces are cut out of the lung they will float, showing that all the air has not been excluded from the air cells. The capillary vessels are greatly distended, the alveolar epithelium swollen, and the air cells occupied by a variable number of blood corpuscles and detached alveolar cells. In the stage of red hepatization the lung tissue is solid, firm and airless. If the entire lobe is involved, it looks enlarged and shows indentations as the result of rib pressure. On section, the surface is dry, reddish-brown in color, and has the marked congestion of the first stage. It is friable, in striking contrast to the healthy lung, which is torn with great difficulty. The air cells are filled with fibrinous plugs, giving to the surface a granular appearance. The smaller bronchi, also, often contain fibrinous plugs. Microscopically, the air cells are seen to be occupied by coagulated fibrin and red blood corpuscles, also many small round cells and polymorphonuclears. When smears are

¹ Read before the Radiological Society of North America, at Cleveland, Ohio, December, 1925.

made the pneumococci are found in large numbers, and many are intracellular. In the third stage, that of gray hepatization, the lung tissue has changed from a reddish-brown color to a grayish-white color. The surface is more moist and the lung tissue is still more friable. The air cells are filled with leukocytes; the fibrin network and the red blood corpuscles have decreased markedly in number. The next is the stage of resolution. This, in all probability, is due to an autolytic digestion by proteolytic enzymes which are present in the stage of gray hepatization, and the dissolved exudate, for the most part excreted by the kidneys.

The clinical diagnosis is usually quite easy to be arrived at. Little is known of the incubation period: it is probably very short.

All roentgenologists and clinicians are familiar with the well known and, in most cases, characteristic shadows seen in the roentgenogram of lobar pneumonia. Wessler and Jaches, in "Clinical Roentgenology of Diseases of the Chest," state: "The roentgen shadow of a lobar pneumonia owes its more or less characteristic appearance both to the nature of the pulmonary exudate and to its lobar distribution. To the former we can ascribe the homogeneity of the shadow which results from a consolidation of the lung; the latter accounts for its configuration, which is determined by the shape of the individual lobe or lobes which are affected by the disease."

Unfortunately, we find a wide divergence in the shape and size of shadows cast by a pneumonic consolidation, to be explained by a number of factors. First, a lobe may be only partially consolidated, which causes a variation in the shadow and does not give the exact shape of the lobe. We find this occurs most frequently in the upper lobe pneumoniae, especially in children. Second, we must consider the position of the diseased lobe in relation to the uninvolved adjacent lobe or lobes. The main interlobar fissure is an oblique plane, causing the

lobes to overlap at certain levels. This causes an attenuation and thinning of the shadow cast by a consolidated individual lobe, because of the air-containing lung in the unconsolidated lobe either overlapping or being overlapped by the diseased lung.

Another point of exceeding importance which causes variation in the shape of the shadows is the position of the target of the tube with respect to the consolidated area in the lung, and also the position of the patient—whether he be in the ventrodorsal position on the film or plate, or *vice versa*.

In the time allotted it would be impossible to go more deeply into the radiographic findings in lobar pneumonia, and we do not feel that it is necessary to enlarge on a condition which is so well covered by many authors and familiar to us all.

In passing, however, we do wish to emphasize the point that every case should be radiographed as soon as possible. This is especially true in children and even in some cases in adults with the symptoms of an acute surgical abdomen. It has been the experience of us all that in these baffling conditions patients have in some cases been subjected to a laparotomy, whereas, if a roentgenogram had been taken, the diagnosis of pneumonia would have been established. A negative roentgenogram of the chest will then mean an intra-abdominal lesion. To quote from Wessler and Jaches: "The roentgen examination is peculiarly reliable in these cases because in the earliest stages of lobar pneumonia encountered clinically, even before physical signs are present, well marked shadows are already to be seen." This point cannot be too strongly emphasized and we should all constantly urge this upon our clinical consultants. It is of great interest, although unfortunately we do not often have the privilege, to see a case of lobar pneumonia from its onset until the patient is discharged from the hospital, cured.

The earliest sign which one can expect to find is a slight accentuation of one hilus shadow and a definite increase in the linear

markings. This increase in the markings may be throughout one lung or may be limited to one of the lobes. The sequence of events will then be the appearance of a hazy, rather thin, shadow, which, again, may involve an entire lung or one or more lobes. If the patient is radiographed again within twenty-four hours, or perhaps slightly longer, one will see that this slight haziness is becoming more or less opaque and in all probability at this time may show the complete configuration of one lobe of the lung. This process perhaps goes on until the radiograph shows a complete, dense, white shadow. If we then continue to follow the case we will find that the diffuse opacity of the shadow is becoming less and there is more or less mottling by areas of increased and decreased density. This, of course, indicates a resolution of the process, and, finally, the only finding which is left is perhaps a faint mottling and accentuation of the linear markings. These signs persist for some time, even for a month or more. We are not now considering a case of unresolved or delayed resolution but one which is apparently quite normal in its convalescence.

A word of caution should be given here as to confusing these late signs of resolving lobar pneumonia with pulmonary tuberculosis, especially if the pneumonic consolidation involves the upper lobes of either or both lungs. At times the findings are so characteristic of tuberculosis that a clinical history must be taken into consideration, and, in addition, when there is any doubt the patient should be re-examined in from six weeks to two months. If at this examination we find that the accentuation of the linear markings is decreasing, we can then feel quite sure that the case is not one of tuberculosis.

In our investigation of this subject we are concerned only with the early signs of lobar pneumonia. It is quite obvious that if the different types of the pneumococcus have a predilection for different lobes of the lungs, we must secure the radiographs as soon after the onset of the disease as pos-

sible, before extension to the other lobes of the lung has begun.

It is interesting to note here some of the conclusions in the October 1, 1917, edition of the Monographs of the Rockefeller Institute. The statement is there made that lobar inflammation of the lung may be caused by a number of different bacteria, but that the vast majority of the lesions are caused by the varieties of the *diplococcus pneumoniae*. To quote from the Monographs: "Among 529 cases diagnosed from the clinical and pathological features as acute lobar pneumonia, the following were the etiological agents concerned:

Diplococcus pneumonia	454
Friedlander's bacillus	3
Bacillus influenza	6
Streptococcus pyogenes	7
Streptococcus mucosus	1
Staphylococcus aureus	3
Mixed infections	6
Undetermined	49
	529"

They go on to say that the result of their studies showed that the pneumococci fall into two general classes, the larger class including Types I, II and III, and the smaller Type IV. Type IV represents about 20 per cent of the strains isolated from cases of lobar pneumonia and is the most frequently encountered in the mouths of healthy individuals.

In their studies of 454 cases of lobar pneumonia they give the following percentages of occurrence of the various types:

Pneumococcus Type	No. cases	Incidence %
I	151	33.3
II	152	33.5
III	59	13.0
IV	92	20.3

Our investigation was begun by going through all the case histories on file in the Record Room from 1916 to date. From this investigation we prepared a series of 357 cases from which we found the percentages of occurrence of the various types to be—

Pneumococcus Type	No. cases	Incidence %
I	101	28.2
II	48	13.4
III	15	4.2
IV	193	54.07

The points of difference in our series are a marked diminution in the percentage of Type II infections and a marked increase in Type IV. Therefore, in our series one is likely to encounter atypical pneumonia more often, this being borne out by a study of the radiographs.

From a series of 357 cases we compiled the following table:

<i>Right lung</i>	Pneumococcus Type	No. cases	Percentage
Upper lobe	I	15	13.8
	II	3	2.6
	III	6	5.4
	IV	86	78.2
Total number of cases, 110.			
Middle lobe	I	15	42.8
	II	11	31.4
	III	2	5.7
	IV	7	20.0
Total number of cases, 35.			
Lower lobe	I	29	34.9
	II	11	13.3
	III	3	3.6
	IV	40	48.4
Total number of cases, 83.			
<i>Left lung</i>			
Upper lobe	I	7	20.0
	II	4	11.4
	III	1	2.8
	IV	23	65.7
Total number of cases, 35.			
Lower lobe	I	35	37.2
	II	19	20.2
	III	3	3.21
	IV	37	39.3
Total number of cases, 94.			

In studying the above tabulation more closely one will see that in 110 of the cases of lobar pneumonia in the upper lobe of the right lung, pneumococcus Type IV was the causative agent in 78.2 per cent. Is one, therefore, justified in drawing the conclusion that if a consolidation of the right upper lobe is seen on the X-ray film, the

causative germ is probably pneumococcus Type IV, in over two-thirds of the cases?

If we now study the middle lobe we find that pneumococcus Type I is responsible for 42.8 per cent; Type II is responsible for 31.4 per cent, and Type IV is responsible for only 20 per cent.

The lower lobe reveals that Type I and II are responsible for some 48 per cent, whereas Type IV is responsible for some 48.4 per cent, so that here we seem to find that a lower lobe consolidation in the right lung may be the result of any of the above organisms. In addition, Type III, although a small percentage of all cases, may occur in any of the three lobes.

If we now go to the left lung and consider the upper lobe, we find that Type IV is responsible for 65.7 per cent, which is 15 per cent over one-half of the infections, but, again, Types I and II are responsible for some 31.5 per cent, whereas Type III follows out the rule which held for the right and is relatively rare.

We now go on to the consideration of the left lower lobe. Here, again, we find that Type I is 37.2 per cent and Type IV is 39.3 per cent, so that again we are forced to the conclusion, as we were in the lower lobe of the right lung, that it is an open question whether the type is I or IV. Type II, on the other hand, shows 20.2 per cent of the infections, which is somewhat above the percentage in the lower lobe of the right lung. It would seem from these figures, which, of course, are only relative, because we do not feel that 357 cases is a sufficient number from which to draw definite conclusions, especially as a number of these cases occurred during the influenza epidemic in 1917-1918, that we have not sufficient data to be definitely sure as to whether or not the figures would remain the same in a larger series of cases. However, it does seem that the general trend of the figures would lead one to suspect that pneumococcus Type IV is the organism most frequently found in the upper lobe of the right lung and the upper lobe of the left lung. However, the lower lobes of both

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lungs also show a high percentage of Type IV infections. The Type IV pneumococcus, of course, being atypical, one would expect it to give rise to atypical pneumonia, and lobar pneumonia of the upper lobes of both lungs is atypical from the clinical standpoint.

We feel that if the consolidation of lobar pneumonia of the upper lobe of either the right or left lung is detected on the X-ray film, one is warranted in saying that the causative agent is most probably pneumococcus Type IV and our chances of being correct in this will be 75 per cent. Another interesting feature is the fact that Type I pneumococcus is the next most frequent and Types II and III may be considered rare. The figures for the middle lobe of the right lung are by no means conclusive and the three main types are quite close together in their frequency of occurrence.

When we come to the discussion of the lower lobes of either the right or left lungs we find that the organism in frequency of occurrence is, first, Type IV and then Type I, with the other organisms occurring rarely, and we do not feel that the diagnosis of the type of invading pneumococcus is justified from an X-ray examination.

CONCLUSIONS

In concluding from the above, we do not feel that it is justifiable to make an X-ray diagnosis as to the invading organism in lobar pneumonia. However, the percentages in our series indicate that, should one have the audacity to say that there is lobar pneumonia present in the upper lobes of either the right or left lung, probably due to Type IV pneumococcus, the chances are that one would be correct in 75 per cent of cases. This is slightly more true of the right upper lobe than of the left.

DISCUSSION

DR. W. W. WASSON (Denver): I think if I were to discuss this paper, it would be rather in a general way. Dr. Rosenow perhaps has led the medical profession in the study of the selection of tissue by organ-

isms. He has shown us certain germs from a tooth, for instance, which have selected a nerve or perhaps the duodenum. I feel that any of us, during epidemics of sinus trouble, observe that at times we have involvements of mastoids; at other times, during epidemics, we do not have much mastoid trouble. Turning to the chest we all observe that we have germs that cause bronchitis; we have germs that cause bronchiectasis, frequently associated in sinus cases, whether it is bronchitis or bronchiectasis. Then we have germs that involve the parenchyma of the lungs, such as pneumonia. In this case it is the diplococcus. Then we have the tubercle germ that involves the parenchyma or the lymphatic structures. Now, in order to make any study of the situation, we have a great many factors that we must consider. In the first place, the lungs have a wider variety of disease than any other similar structures of the body: they are the only internal organs that are directly connected with the outside air; they are connected by the lymphatic streams both with the abdomen and the neck and head. All the blood of the body must go through the lungs at some time or other. Now these four great factors must play a large part in any infection of the lungs—and as to its location. I fancy that a particle of dust or other infecting material coming from the air into the trachea has a pretty fair chance of going into the right lower lobe. We know that foreign bodies do that. Again, it is a chance whether the infection goes into the right lower lobe or selects one of the other bronchi and produces a pneumonia in the upper, lower or middle lobe. Again, if the infection is circulating in the blood, I fancy it is quite a chance whether it is deposited in an upper or a lower lobe. Infection coming into the lymphatic stream from the neck or sinuses or the head will pass down through the upper mediastinum, which is directly connected through the hilus on either side with the lung. The same is true of an infection coming from the abdomen. In a study of this sort we must consider all

these factors. We must consider the element of chance and I believe it plays a great part. Yet we all feel that tuberculosis primarily involves apices. The tissue reaction comes in as an important factor. We see typical cases with all the cardinal signs, and we see atypical cases. Those atypical cases may be purely atypical reactions or may be influenced by the anatomical factors I have spoken of. If we have atypical germs we have atypical reaction of the tissue, and yet, if we have typical germs, the body does not always react the same; so if the body does not always react the same, if we have atypical germs, and if we have so many factors entering into this problem, I say we must consider all of these before making final conclusions.

DR. SETH HIRSCH (New York): It seems to me that it is important for one who practices any particular art to know the limitations of the art. That idea arose in my mind when the Doctor demonstrated that a particular type of pneumococcus is responsible for consolidations in a certain portion of the lung. I do not suppose he intends to substitute the X-ray examination for the bacteriological examination, and further, I do not see that it is within the province of the roentgenologist to state, even if there is a 75 per cent certainty, that that particular pneumonia is due to a certain type of pneumococcus. It seems to me that the art of lung diagnosis is sufficiently difficult without complicating it any further. Not only is the art of diagnosis itself difficult but the expression of the findings, the roentgen findings, in intelligible language appears also to be extremely difficult. It appears to be more difficult to interpret interpretations than to interpret things themselves. I do not know what a white shadow is and I never saw a solid shadow, and do not know what "increased markings of the lungs" means, and many similar wild terms that are used, these days, in reading X-ray films of lungs. In the diagnosis of pneumonia the technic is extremely important, and I doubt very much if we will get very far with our pres-

ent method of making films of the chest. I mean by this, the Coolidge tube method with the broad focus tubes and the long exposures.

It is hazardous to make a diagnosis of pneumonia on a mere enlargement or distortion of the hilus shadow; it is necessary to see a change in illumination, and with a child suffering from pneumonia, restless and breathing rapidly, a fairly long exposure with the Coolidge tube will not show the very slight changes in illumination which may be due to beginning exudation in the air vesicles. Some day we will go back to a technic we were on the verge of perfecting, a technic which enabled us to make an exposure of the chest in a small fraction of a second without the intensifying screens. Then the detailed study of consolidations will be possible—more clearly than they are now. A great deal of difficulty arises in the diagnosis of consolidations of the left lung, particularly in children, because they frequently have patches of disease on the left side, which, in the usual sagittal exposure, show merely as an increase in size of the hilus shadow and a distortion of its form,—the area of consolidation being hidden by the heart. Therefore, when such enlargement of the hilus shadow is marked or the clinical signs indicate it, an eccentric view of the chest is necessary to demonstrate the consolidation.

DR. BELDEN (closing): In closing the discussion I would like to say that I had no intention, when writing this paper, of making a bacteriologic diagnosis by the X-rays, but I considered it of interest to discover whether the different types of the pneumococcus had a predilection for the different lobes of the lung, and I still feel that this is of interest.

I might add that we are all aware of the fact that we have only scratched the surface in roentgenological diagnosis and we have high hopes of becoming more proficient in this most difficult field of lung pathology.

In extenuation of my position in undertaking this work, one may mention that the

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tubercle bacillus has a special predilection for the upper lobes of the lung, and when we find a lower lobe tuberculosis we consider it an exception to the rule. Personally, I believe that one would be justified in making a diagnosis of tuberculosis when the X-ray reveals only a lower lobe lesion.

It seems hardly necessary to bring up the question of technic because I feel that we are all familiar with that phase of radiology. However, Dr. Hirsch's point of instantaneous exposures is well taken, but it seems like "bringing coals to Newcastle" to mention it before a Society of this kind.

Bacilli causing malignant tumors.—Blumenthal, the Director of the Cancer Research Institute in Berlin, and his co-workers, H. Auler and P. Meyer, have discovered a number of bacilli in lymph taken from the tissue surrounding malignant growths in man. With one group, the so-called *Bacillus PM*, Reichert has carried out a number of experiments to investigate its properties in regard to transplantation, growth, metastasizing, and recurrence. Rats proved to be the animals best suited for these experiments. After a hypodermic injection of an emulsion of *Bacilli PM* and silicious marl, a nodule developed, usually in ten days' time, at the site of injection. Tumor paste injected at that time stimulated the growth considerably. This primary tumor could easily be transplanted, and showed an infiltrating growth causing metastasis to the inner organs. Controls were done with the injection of tumor paste only.

Morphologically, this *Bacillus PM* is very similar to the already known *Bacillus Tumefaciens* (Smith), which causes tumors in plants. The *Bacillus PM* cannot be isolated from the tumors in rats. The author, therefore, believes that it is not the bacillus itself that causes the malignant growth but some still invisible virus attached to it. He states very definitely that no claim is made to the effect that this *Bacillus PM* may be the "cancer germ." Whether or not this discovery can be used therapeutically requires further investigation.

ERNST A. POHLE, M.D.

Bisallogenic Tumors and Tumor-causing Bacilli. F. Reichert. *Deutsche med. Wchnschr.*, 1925, No. 32, p. 1306.

Nasal accessory sinuses.—The writer emphasizes in this article the fact that lowering of the visual capacity and blindness from disease of the nasal accessory sinuses are far more common than is generally supposed. Particularly does disease of the ethmoid and sphenoid enter as a contributory group. The writer here emphasizes the direct anatomical relation of the optic commissure to the sphenoid sinus. The optic commissure is very often situated directly over the sphenoid, so that disease of this sinus may easily affect the nerve at this point, either by direct extension through bone necrosis or by dehiscence of the sinus wall at this point or through collateral edema and inflammation by extension from the sinuses. He states that a negative X-ray report on the sinuses does not exclude the possibility of sinusitis as a contributory factor in the optic disease. Several cases are described in which the X-ray showed no disease of the accessory nasal sinuses, regardless of which a surgical procedure was instituted to remove all scar tissue from the ethmoid areas and to remove both middle turbinates. This procedure was followed in all cases described by an immediate and progressive improvement in the optic condition, with a resultant improved vision.

The writer stresses the need of prompt action in all cases of optic involvement and of exploring the ethmoid sinuses particularly, regardless of negative X-ray and clinical findings relative to these sinuses.

B. C. CUSHWAY, M.D.

The Significance and Prevention of Blindness Due to Intranasal Disease. Mark J. Gottlieb. *Laryngoscope*, Nov., 1925, p. 844.

POTTER-BUCKY DIAPHRAGM TECHNIC

By E. C. JERMAN, CHICAGO

FOLLOWING proper calibration of the equipment, it should be carefully charted for the various regions and positions of the body with which it may be desirable to use the diaphragm. The following table is to be used as a guide in the charting process. The first step is to fill in the P.R.V. (pre-reading or autotransformer) column of the table with the necessary P.R.V. for each K.V.P. (kilo volts peak) and for each milliamperage shown. The various P.R.V.'s may be obtained from the calibration chart. Only one P.R.V. is required for the 10 ma. column, one for the 20 ma. column and one for the 30 ma. column. It is suggested that the time of exposure be made the variable factor in diaphragm work, when using the 10, 20 and 30 ma. technic, in order to avoid the danger of exceeding the 87 K.V.P. which is the limit of both the 5-10 and the 5-30 radiator tubes. As with extremity work, a variation of 2 or 3 P.R.V. or K.V.P. is not material, but a variation of 5 or more should be avoided if at all possible.

The ma. technic is suggested for all bone work, in order that the finer detail to be obtained with the use of the smaller focal spot of the 5-10 radiator tube may be made available. The 5-10 tube should never be used above its rated capacity of 10 ma. at 87 K.V.P. The 5-30 radiator tube or the fine focus universal tube should be used for the 20 ma. and the 30 ma. technic, and either tube may be used with the 10 ma. technic as well. Another advantage of the 10 ma. technic over the 20 or 30 ma., is due to the fact that it provides a greater latitude of the time, K.V.P. and dark room factors. The 20 and 30 ma. technics are advisable when, on account of the condition of the patient, it becomes necessary to sacrifice detail for a shorter exposure time. Where the time of exposure exceeds 30 seconds, such as with the lateral lumbar spines of the larger patients, the

exposure should be made in two or more relays. For example, if the time of exposure is to be 40 seconds, two 20-second exposures should be made, with the grid travelling twice across the film. Adequate means for the immobilization of the patient or part to be radiographed should always be employed. For kidney and gall-bladder work, where the maximum of soft tissue differentiation is desired with as nearly as possible absolute immobility of the part, and for stomach and colon work where a short time is advisable in order to avoid involuntary movement, the 100 ma. technic, with its corresponding shorter exposure time and lower K.V.P., is suggested. The 100 ma. technic requires the use of an accurate time switch and will be more accurately duplicated with the use of a stabilizer. The 5-100 radiator or the medium focus universal tube should be used for all 100 ma. work with the diaphragm.

THE USE OF THE TECHNIC CHART

Because of the variability in speed of films, speed of screens, of the size or thickness of the part to be exposed, or its transparency or opacity, or of pathological conditions, any chart that may be prepared can be used only as a starting point. The technician, after viewing the part to be exposed, must use his best judgment regarding any variations from the chart. His judgment or skill will improve rapidly with practice and experience, if the chart be used constantly as a guide. When the part to be exposed has been placed in the proper position, he should decide upon the technic to be used—he may use the 10 ma.-87 K.V.P.; the 20 ma.-87 K.V.P.; 30 ma.-87 K.V.P., or the 100 ma. technic. After the technic has been selected for a given subject, and the proper tube placed in position, the film, screen, distance, K.V.P. and milliamperage factors should be kept constant except for 100 ma. work. When the 100

The distance ordinarily used with the Potter-Bucky diaphragm is 25 inches. Thirty inches is suggested with the lateral dorsal and lumbar spine, due to the fact that the spine is so far away from the film in this position. Double intensifying screens are recommended for all diaphragm work in order that smaller focal spot tubes and shorter exposure times may be used. It is perfectly feasible, if so desired, to increase the exposure time and lower the K.V.P. factor, with a resulting increased contrast.

NORMAL MEDIUM SIZE ADULT WITH FILM, DOUBLE SCREENS AND POTTER-BUCKY DIAPHRAGM

Subject—	Pos.	Dist.	10 ma.			20 ma.			30 ma.			100 ma.		
			P.R.V.	K.V.P.	Sec.	P.R.V.	K.V.P.	Sec.	P.R.V.	K.V.P.	Sec.	P.R.V.	K.V.P.	Sec.
Head	Lat.	25		87	4		87	2		87	1½			
Frontal sinus	P.A.	25		87	10		87	5		87	3½			
Shoulder	A.P.	25		87	2		87	1		87	¾			
Dorsal spine	A.P.-P.A.	25		87	10		87	5		87	3½			
Dorsal spine	Lat.	30		87	15		87	7½		87	5			
Lumbar spine	A.P.	25		87	7		87	3½		87	2½			
Lumbar spine	Lat.	30		87	35		87	17½		87	12			
Pelvis	A.P.	25		87	6		87	3		87	2			
Urin. bladder	A.P.-P.A.	25		87	6		87	3		87	2			
Kidney	A.P.	25		87	7		87	3½		87	1½			2
Feel	A.P.-P.A.	25		87	20		87	10		87	7			
Gall bladder	P.A.	25		87	6		87	3		87	2			2
Stomach	P.A.	25								87	2			1
Colon	A.P.	25								87	2			1

The distance ordinarily used with the Potter-Bucky diaphragm is 25 inches. Thirty inches is suggested with the lateral dorsal and lumbar spine, due to the fact that the spine is so far away from the film in this position. Double intensifying screens are recommended for all diaphragm work in order that smaller focal spot tubes and shorter exposure times may be used. It is perfectly feasible, if so desired, to increase the exposure time and lower the K.V.P. factor, with a resulting increased contrast.

ma. technic is used, the film, screen, distance, time and ma. factors should be kept constant.

If either 10, 20 or 30 ma. technic is selected, and with the above factors for these technics fixed, there is but one time of exposure that will give the best possible results. The problem is to find that time of exposure.

For example: Subject, pelvis; technic selected, 87 K.V.P., 10 ma., 25-inch distance, 5-10 radiator type tube.

If the pelvis is medium size, by reference to the above table it will be found that 6 seconds exposure is to be used. If the pelvis is larger than medium, use a longer time of exposure; if the pelvis is smaller, use a shorter time of exposure. When the exposed film has been developed it will be at once apparent whether or not a longer or a shorter time of exposure should have been used for that subject. If the radiograph is too dark, a shorter time of exposure should have been used; if too light, a longer time of exposure should have been used. If it is desirable to improve the density, another exposure can be made. The second guess should be better than the first.

If the 100 ma. technic is to be used, the variable factor is K.V.P. For example: Subject, kidney; 100 ma., 25-inch distance, 2 seconds, medium focus universal or 5-100 tube.

If the subject is of average medium size, by reference to the above table it will be found that 68 K.V.P. (you will have already determined the necessary P.R.V. for that K.V.P.) is to be used. If the subject is larger than medium, use a higher P.R.V. (K.V.P.), and if smaller, use a lower P.R.V. (K.V.P.). When the exposed film

is developed it will be at once apparent whether or not a higher or lower P.R.V. (K.V.P.) should have been used. If the radiograph is too dark, a lower P.R.V. (K.V.P.) should have been used; if too light, a higher P.R.V. (K.V.P.) should have been used.

SUMMARY

The tube, the film, the screen, the milliamperage, the distance, and the K.V.P. (P.R.V.) are all fixed when using either the 10, 20 or 30 ma. technic, the time of exposure factor only to be varied for the purpose of obtaining the desired result. In routine practice, after selecting one of the above technics for a given subject, it only remains for the technician to decide what time of exposure is to be used.

When using the 100 ma. technic, the tube, film, screen, milliamperage, distance and time of exposure are all fixed, it being only necessary for the technician to decide what pre-reading voltage (K.V.P.) should be used.

Following the calibration and charting of the equipment, in routine practice, the K.V.P. may be ignored except when it may be desired to impart or receive information to or from others regarding the K.V.P., or penetration factor, value.

A given K.V.P. means the same value, when properly measured, wherever it may be used and with all equipment.

A given P.R.V. (pre-reading or autotransformer) voltage may have one value with one equipment and another value with another equipment. Consequently, the pre-reading voltage required to produce a given K.V.P. value must be worked out with each individual equipment with a sphere gap.

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EDITORIAL

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STANDARDIZATION

The preliminary report of the Committee on Standardization of X-ray Measurements, which was read and approved at the Cleveland meeting of the Radiological Society, and was published in the March number of *RADIOLOGY*, contains three recommendations:

1. That an iontometric method be used to determine the output of X-rays;
2. That for the present, at least, *quantity* of radiation be expressed by the electrostatic unit "e," or its equivalent, "R," as defined by Behnken;
3. That *quality* be expressed in terms of either average wave length, effective wave length, the half value layer, or the coefficient of absorption.

While these recommendations, of course, apply only to members of the Society, they are considerably reinforced by the adoption by the United States Bureau of Standards of the electrostatic unit as a measure of quantity, until such time, at least, as an international unit shall be selected and defined.

At a recent meeting of the Committee in Washington, officials of the Bureau of Standards expressed their willingness to assume the tremendous task of standardizing and calibrating measuring instruments in absolute units as soon as the necessary equipment and personnel can be provided. Such co-operation, and that proffered by various physicists throughout the country, practically assures the success of the Committee, at least in its effort to solve the more pressing physical problems presenting themselves.

MANLY J. SANDBORN: IN MEMORIAM

Manly Jay Sandborn was born July 25, 1869, at Freedom, Wisconsin, and died at Appleton, Wisconsin, February 20, 1926. He left to mourn his passing, besides his many friends, a beloved wife and one son and one daughter.

Dr. Sandborn was graduated from the public schools of Appleton and received the degree of B.S. from Lawrence College in 1892. He was graduated from the Northwestern University Medical School in 1896. Since that time Dr. Sandborn has practised medicine in Appleton, Wisconsin, until the time of his death, except for three years—1899–1902—during which time he served as surgeon to the Colorado Fuel and Iron Company, at Brookside, Colorado.

After his return from Colorado in 1902, Dr. Sandborn began the use of the X-ray in his work. By his industry and studious application to his work he became one of the leading radiologists of the country. For a number of years his entire time has been given to radiology alone.

Dr. Sandborn's talents, application to duty and sincerity of purpose made him an outstanding figure in the profession in his State. He twice held the office of President of his county society, as well as serving for a number of years as its secretary. He took an active part in the work of the Wisconsin State Medical Society, serving in various capacities in its activities. A charter member of the Radiological Society of North America, he has been a powerful factor in bringing it to its present high state of usefulness. In 1918 he was elected Secretary of the Society, which office he filled with credit to himself and satisfaction to the membership until his election to the presidency of the Society in 1924. At the time of his death Dr. Sandborn, as President, was actively engaged with the Program Committee in arranging for the Annual Meeting in Milwaukee in Nov.–Dec., 1926.

In addition to his membership in the Radiological Society of North America, Dr. Sandborn was a member of his county society, the Wisconsin State Medical Society, the American Medical Association, the Fox River Valley Medical Society, the Tri-State Medical Society, and the American College of Radiology. He was on the active staff of St. Elizabeth's Hospital, of Appleton, and was also a member of Phi Rho Sigma Medical Fraternity.

Dr. Sandborn's activities were not confined to medicine. He was an honored member and trustee of the First Methodist Church, of Appleton, a member of the Young Men's Christian Association, the Masonic Lodge, the Rotary Club and the Chamber of Commerce of Appleton, to all of which, as well as to the community itself, he gave freely of his time and talents.

Honored by his fellow-townsmen for his personal and civic virtues, trusted and appreciated by the physicians of the community and of the State for his professional ability and good judgment, and beloved by the members of the Radiological Society of North America for his kindly disposition, his brotherly bearing, and his uniformly courteous manner, he died in the prime of life, rich with honors and appreciation.

Be It Resolved: That the members of the Radiological Society of North America mourn the loss of a valued and beloved fellow-member: That they are grieved to know that they shall no longer feel his influence in their meetings, nor be permitted to counsel with him in their trials.

Be It Further Resolved: That a copy of this appreciation be sent to the bereaved wife and son and daughter of Dr. Sandborn; that a copy be sent to RADIOLOGY for publication, and that these resolutions be spread upon the minutes of the Society.

JOHN F. HERRICK, M.D., *Chairman,*

L. R. HESS, M.D.,

LEON T. LEWALD, M.D.,

WILLIAM E. CHAMBERLAIN, M.D.,

LEROY SANTE, M.D.,

Committee.

DR. MANLY J. SANDBORN

Though 'tis yet early eve, he has gone to his rest.
Tread lightly; disturb not his sleep.
His day has been full, and at times hard-pressed,
He has shirked no stern task; given all of his best.

And in measure of manhood has met every test.
May his slumber be calm and deep.

—S. D. G.

CHARLES C. GRANDY: IN MEMORIAM

Charles C. Grandy, M.D., formerly a member of the Executive Committee of the Radiological Society of North America, died February 12, 1926, at his home in Fort Wayne, Indiana, of chronic nephritis, following an illness of five months.

Dr. Grandy, who had practised radiology in Fort Wayne since July, 1911, was born July 7, 1885, in the town of Wall Lake, Iowa, and lived during his young manhood in Warsaw, Indiana. He was married June 5, 1912, to Miss Paullena Longacre, of Elkhart, Indiana. He was a graduate of Indiana University and of Rush Medical College, Chicago. In Fort Wayne he joined the staff of the Lutheran Hospital. During recent years he has been a member of the Duemling Clinic and an X-ray and radium specialist.

He was a member of the Allen County Medical Society, a Fellow of the American Medical Association, a member of the Northern Tri-state Medical Association, the Radiological Society of North America, and the American Roentgen Ray Society. He was a charter member of Nu Sigma Nu of Indiana University, a member of the Honorary Fraternity Sigma Xi, the American Institute of Electrical Engineers, the Sol D. Bayless Lodge of F. and A. M., and the Kiwanis Club of Fort Wayne.

Dr. Grandy is survived by his widow, three children—Alice, Charlene, and John—by a sister, Miss Ruth Grandy of Fort Wayne, and a brother, Frank Grandy of Indianapolis.

The Committee on Necrology of the Radiological Society of North America offers



The Late Dr. Charles C. Grandy

the following resolution on the occasion of the death of Dr. Charles C. Grandy:

As a member of the Radiological Society of North America Dr. Charles C. Grandy, by his quiet, unobtrusive, kindly manner, made himself one of the beloved members of the Society. And because of his thorough understanding of the fundamentals of radiology, his ripe knowledge of the application of the science in the diagnosis and treatment of disease, and his good judgment in all matters, he became a trusted adviser and guide.

Therefore Be It Resolved: That in the death of Dr. Grandy the Society has suffered a most serious loss. That it will miss him in its councils and in its scientific work and especially will its membership miss his kindly greetings.

Resolved: That a copy of this resolution be entered on the records of the Society, and that a copy be sent to the family of Dr. Grandy.

RADIUM RADIATION FROM A GENERAL UTILITY STANDPOINT¹

The introduction of radium into general therapeutic use has been accomplished by much discussion and also considerable unjustifiable criticism.

In the light of past achievements, however, we are in duty bound to review our work with radium and continue in its scientific application, secure in the knowledge that in certain phases of cancer it has demonstrated therapeutic results as yet unequalled by any other medical or surgical measure known.

Outside of the comparatively few institutions where radium is supplied in the form of emanation, the bulk of independent radium therapy is carried on by means of elemental radium in the various glass and metallic containers with which we are all acquainted. With the advent of the aerial mail service, even the remotely located radiologist can have placed at his disposal, upon telegraphic request, a suitable quantity of radon or radium emanation of exact measurement and known content. This service is invaluable to those who have not the facilities of an emanation apparatus.

According to the experience of the writer, the field where the best results have been obtained from radon implants or seeds is the oral cavity, particularly the tongue. In no other location has this form of therapy seemed to us so surely the best, unless it be in such nodules or tumor masses of the rectum, vagina or cervix uteri as will not react so as to injure seriously a functioning mucous membrane. In early cancerous lesions of the tongue, our experience with radon seeds has been gratifying. In the bladder, prostate and rectum, we have not been so fortunate.

In the majority of malignancies, we have noted that outside of a very few favorable cases where a metallic needle imbedded for a limited time gave the desired result, we accomplish a great deal more with much less pain and discomfort to the patient by

¹ Presented for publication Feb. 2, 1926.

the screened applicator method. Similarly, our use of the metallic needles imbedded in tongue or throat lesions have given way, either to the radon seeds or to screened topical application. In tissues which are hyperplastic and free from adjacent sensitive structures, as, for example, polypi or small fibroids of the cervix uteri, judicious employment of metallic needles will yield more satisfactory end-results than any other method of eradication. On the other hand, in cancerous nodules elsewhere located, the response with needles has not measured up to what should theoretically be expected from such treatment. Many of us at one time advocated the use of needles imbedded in the various cancer nodules of the breast. We have, in our Clinic, discontinued this procedure for several reasons, the chief one being the severe reaction and sloughing, with a long, tedious healing period which sorely tries the patience of both the operator and his charge. When we have reverted to the older technic of screened external applications, we have secured equally good end-results with no such serious sequelæ. It makes a great difference, of course, which type and size of needle is used. The small calibered platinum iridium needle does not traumatize greatly and is to be preferred to the heavier steel needle, although its lesser radium content necessitates a longer treatment. Even if we should be compelled to remodel our work entirely upon the more or less debatable ground just considered, it is doubtful if the near future will give the medical profession a more reliable agent than radium, within the limitations to which reference has been made.

It is to be questioned whether in the entire armamentarium of medical science there is any agent or group of agents so universally successful in the treatment of skin lesions, malignant and benign, as that specific energy of radiation exemplified in the element radium. Neither has any single individual or group of individuals produced a method of treatment which will so

surely and effectively correct pelvic conditions as this self-same radium, and this even in cases which are beyond the reach of ordinary surgery or any other known form of treatment. Further, it is by no means established that we have reached the limit of accomplishment in this interesting field of work and we may rightfully claim more time to study and familiarize ourselves more fully with some of the intricate problems which go to make up the basic science radiology.

One source of disappointment with radium work comes from attempting to do massive work with small quantities of radium. This applies specifically to the radium plaques with which many dermatologists attempt the destruction of superficial malignancies. Ordinarily the plaques contain five to ten milligrams of radium element thinly spread over a surface of fused glass from one to two centimeters in diameter. Frequently a patient reaches our Clinic with a small epithelioma of the face thoroughly infiltrating the skin as a result of a slow process of irritation with radium plaques. While these are perfectly satisfactory in seborrheic patches or localized keratoses, they should never be employed where a clinical epithelioma exists. It is far better to use fifty or more milligrams of radium lightly screened in the shape of needles or tubes, and time the same according to the particular lesion in question.

The use of large amounts of radium in an attempt to produce deep therapy from the block method above the body surface is not reasonable, since to divert so much valuable radium energy to a field which can easily be covered in a fraction of the time by short wave X-rays, is sheer waste. In referring to large amounts, I am quoting our own experience with radium packs up to one-half gram radium element, but I am sure the same principle would govern the use of radium up to three or four grams, beyond which no institution could economically make use of radium in any form for single or individualized treatments. We

have demonstrated in our Clinic to our own satisfaction that a three-centimeter skin distance should never be exceeded, and we prefer to work at a one-centimeter distance for so-called deep radium effects. With the lesser distance and with metallic screening, we have never seen a severe skin reaction with amounts up to one-half gram where it was desirable to affect subcutaneous structures up to what we would consider a massive or deep erythema dose. Under this caption we include diseases of the spleen, liver, accessory sinuses, and localized glandular disease, also the many varieties of cancer nodules, either metastatic or from a localized extension.

Is there a cancer dose for radium? Emphatically, no! There is a somewhat elastic unit of dosage which usually suffices in a selected number of cases of easily known pathology, wherein we may reasonably expect a uniform response from a preconceived dose formula. Otherwise, there are just as many variations in dosage as there are types of individuals or manifestations of disease. Many authors claim there is no such thing as idiosyncrasy to radiation, that all such apparent phenomena and irregularities are due to improper treatment. To such opinions, I cannot yield gracefully, as I am convinced that, all things being equal, no other medical agent is more variable in its effects than the energy of radiation, due not to any temperamental quality of its own but to the ever-changing differentiation of the protoplasmic human cell. It is, of course, necessary to have a fundamental standard by which to estimate a basic dosage for a given lesion, and the work of such eminent physicists as Failla, Viol and Dorsey, together with the clinical data from such men as Abbe, Williams, Kelly, Burnam, Boggs, Schmitz, Quick, Aikins, Simpson, Pfahler and a great many others, have blazed a trail which we may safely follow.

ALBERT SOILAND, M.D.,
1407 South Hope Street,
Los Angeles, California.

February 17, 1926.

A LETTER FROM THE AMERICAN REGISTRY OF RADIOLOGICAL TECHNICIANS TO THOSE WHO CONTEMPLATE OFFERING COURSES TO PROSPECTIVE TECHNICIANS

The agreement at the end of the application blank which each registrant has to sign reads as follows, and the certificate issued reads accordingly:

AGREEMENT: If I receive a certificate from the American Registry of Radiological Technicians, I, _____, hereby agree to work at all times under the medical supervision, and under no circumstances to give out written or oral diagnoses or work independently, whether in any private office, hospital or institutional laboratory.

(Signed) _____

The only thing we can say about courses given to prospective technicians is of a critical nature. The first point that comes to my mind is that giving courses to any number of students for instruction fees seems to be a doubtful business proposition. It would seem more feasible to take apprentices now and then into the laboratory and train them, along with little or no tuition fee, advance them in salary from time to time, and use them to fill your own vacancies, or, when they are sufficiently grounded in their work, they could take other positions. But giving courses to classes, unless you know that they are fairly sure of positions, is, to my mind, a doubtful experiment. It would seem that this had better be done under the apprentice system in hospitals or the larger laboratories in order to give the variety possible from the volume of work.

In regard to the matter of diagnosis, we are all convinced that this is not the field of a technician; that the doctor himself must take this burden, even though the technician works for some specialist, as a gastroenterologist, surgeon, or what not.

The technician has neither the preliminary education, medical training nor experience, nor contacts with medical societies, roentgenological societies, and medical literature to give him a foundation, in the first place, or to keep him abreast of the times, in the second place. Besides, any opinion in the way of diagnosis, whether of a fracture, dislocation, bone or joint disease, is in the nature and fact of the practice of medicine.

The medical profession is cursed, and to the public's detriment, by cults and near-doctors and queer doctors of all kinds. We have no intention in the Registry of helping matters grow worse. On the other hand, the American Medical Association, the American College of Surgeons, county medical societies, city and state health departments, are more and more coming toward a definite position that all offices and diagnostic institutions or places or laboratories, shall be under the supervision and control of competent and duly licensed medical men.

If you can bring your work to conform with our conception, which has been well studied out, and is approved by the American Roentgen Ray Society and the Radiological Society of North America, we will be glad to co-operate with you. Your pupils or graduates can be registered as apprentice technicians, and you can give them a reasonable assurance that when they have fulfilled the other requirements, we will welcome them.

Very truly yours,

BYRON C. DARLING, M.D.,
President.

LAY RADIOGRAPHERS AND MEDICAL REPORTS¹

The Society of Radiographers, as reported in a letter from London to the American Medical Association, has passed a rule preventing lay members from making any

report or diagnosis on any roentgenogram or screen examination, but it was agreed that this rule should be interpreted to allow a lay radiographer (in the absence of a medical radiologist) to describe to a physician the appearances seen in a roentgen-ray examination, so as to assist him in making a diagnosis. The Institution of Electrical Engineers, which took part in the foundation of the Society of Radiographers and nominated six out of the eighteen members of its council, has withdrawn its nominees and terminated the institution's connection with the society, because it considered that the new rule would materially lower the professional status of non-medical radiographers. An attempt had been made previously by a representative of the institution to modify the proposed rule by moving that it be amended so as not to be applicable to members of the society who had been engaged in roentgen-ray work for not less than fifteen years. Such members would thus be allowed to interpret roentgenograms, make screen examinations and diagnoses, and treat patients. Objection was taken to this by the General Medical Council, which pointed out that if such a clause was inserted in the rule the medical members of the society would find themselves in the untenable position of associating with unqualified persons who were performing medical functions without medical training or without immediate personal medical supervision. This decision the medical members of the Society of Radiographers could not, of course, dispute. Nevertheless, the Institution of Electrical Engineers maintained its position. A large proportion of the radiographers, however, have expressed agreement with the new rule.

UNANIMITY OF ACTION

The following letter, received by the President of the Radiological Society of North America, speaks for itself. It gives expression to the spirit of fellowship, of cohesion, of interest in a common cause

¹ Reprinted by permission from the Jour. Am. Med. Assn., Dec. 12, 1925, p. 1901.

characteristic of this Society, which breaks on no lines of cleavage, geographical or social.

New Orleans, Louisiana,
December 26, 1925.

Dr. Manly J. Sandborn
President of the Radiological Society
Appleton, Wis.

Dear Doctor:

Because a number of the members of the Society have expressed the fear that either the Section Meeting in Dallas or the Annual Meeting in New Orleans would suffer from the fact that both these meetings will be held next year in the South at points comparatively close to each other and more or less remote from our centers of population, we believe it our duty to the Society to write you that if you and the Executive Committee deem it best for the good of the Society to change the meeting place for the 1926 meeting, and to come to New Orleans at some later date, that we who invited you and are particularly anxious for you to hold the 1926 meeting in New Orleans, would be perfectly agreeable to any change or arrangement which would best serve the interest of our specialty.

Wishing you the compliments of the season, we beg to remain,

Sincerely yours,

TRACY J. GATELY, M.D.
LUCIEN A. FORTIER, M.D.
ERNEST C. SAMUEL, M.D.
ELEAZER R. BOWIE, M.D.
AMEDEE GRANGER, M.D.

Milwaukee, Wis.,
Feb. 24, 1926.

Dr. Amédée Granger
921 Canal St.
New Orleans, La.

My dear Dr. Granger:

At a meeting of the Milwaukee County Radiological Society and allied Medical Bodies of the County and State held Saturday, Feb. 13, 1926, the following resolution was unanimously adopted and the Sec-

retary instructed to communicate the same to you:

It is the unanimous wish of the Milwaukee County Radiological Society and the allied Medical Bodies of the County of Milwaukee and State of Wisconsin that a vote of thanks for their courtesy in relinquishing their title to the convention of the Radiological Society of North America for 1926, be extended to Dr. Amédée Granger and his associates in Louisiana:

And also a vote of thanks to the Executive Committee of the Radiological Society of North America for having selected Milwaukee as the next meeting place for the annual National Convention to be held November 29, 30, Dec. 1, 2, 3, 4, 1926.

Very truly yours,

C. W. GEYER, M.D., *Sec. M. C. R. S.*
H. B. PODLASKY, M.D., *Pres.*

BOOK REVIEWS

ERGEBNISSE DER MEDIZINISCHEN STRAHLENFORSCHUNG. (ROENTGENDIAGNOSTIK, ROENTGEN-, RADIUM-, UND LICHTTHERAPIE.) Band 1. Verlag von Georg Thieme, Leipzig, 1925.

This volume is the first in a new set of publications with quite a different aspect, as compared with the usual new books in radiology. The editors, Holfelder, Holthüsen, Jüngling and Martius, represent a group with widely scattered interests in different radiological fields. They feel that in the past decade the advances in radiology have been so many, so far-reaching, and so widely scattered in various kinds of medical literature that the average radiologist has found it almost impossible to become properly oriented with regard to the present status of many problems. This applies to both the practitioner and the pure scientist. What is needed is some effective means of correlation and unification of existing, available knowledge. To-day there

are very few published monographs on special problems in medical radiology.

The editors of this series hope to produce a group of just such publications, each by a man especially qualified to discuss his particular problem. These monographs are to present as complete and comprehensive an outline as possible. It is expected that they will furnish the scientists a full and accurate foundation for further research, and at the same time be a reliable work of reference for the practitioner.

The present volume certainly justifies the hopes and aspirations of the editors. The first monograph is on the "X-ray Diagnosis of Malignant and Inflammatory Tumors of the Colon," by Fischer of Frankfurt. This is a very complete study, with adequate pathological and surgical control. The author emphasizes the use of his method of combined barium and air enemas, which enables one to see the outlines of many tumors and infiltrating processes.

The next article, on "Bone Atrophy," is by Friedl and Schinz. This, likewise, combines the pathological and radiological aspects. Lorey contributes one of the shorter papers on the "X-ray Picture in Acute Miliary Tuberculosis." The differential diagnosis is carefully considered, and there are a number of extremely beautiful reproductions of plates. Two excellent contributions in the purely physical field are "Spectroscopy in Medical Roentgenology," by Grebe, and "Measurement of Roentgen Rays by Ionization Methods," by Kustner. The latter constitutes practically a complete book in itself, amounting to about two hundred pages.

Glocker contributes a very interesting discussion on the lay-out of X-ray departments, with special reference to protection from the rays. Holthüsen of Hamburg presents a very detailed study of secondary radiation, its physics and clinical utilization.

Schinz and Slotopolsky have contributed a careful histopathological study of the effect of X-rays on the testicle, including the possibility of later restitution of damaged elements.

The last two papers are clinical ones. Lahm contributes a discussion of the "Radiation Treatment of Cancer of the Cervix," while Kurtzahn writes on the "X-ray and Radium Treatment of Esophageal Cancer." Both are very thorough and complete reviews of the various methods used in practical radiation, with a discussion of the end-results.

This first volume of the "Ergebnisse" thus bears out the hopes expressed by the editors. Here we have a series of detailed and complete monographs on matters of X-ray diagnosis, pure physics, biological problems affecting treatment, pathology, and clinical radiotherapy. We shall look forward with great expectations for the appearance of the succeeding volumes.

I. GERBER, M.D.

LA HAUTE FREQUENCE EN OTO-RHINO-LARYNGOLOGIE, by Leroux-Robert. Paper. Price 15 francs. Pages 166, with 74 illustrations. Paris: Masson et Cie, 1925.

In this little book the author, who is a pioneer in the use of high frequency currents in the medical and surgical treatment of diseases of the ear, nose and throat, discusses the application of such methods and the results to be obtained from them. The methods and the apparatus used by him are described in detail in connection with each disease. This work may prove of interest and perhaps of distinct value to ear, nose and throat specialists. The subject matter is well arranged and the discussions and descriptions are brief and to the point.

A. U. DESJARDINS, M.D.

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ABSTRACTS OF CURRENT LITERATURE

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Backache.—When a patient applies for relief from a backache one should attempt to visualize mentally, if possible, in what tissue the pain-producing lesion lies. Is it in the bone, the joint with its component parts of ligament and synovial membrane, the muscle or its tendinous attachments, or is it in the nerve trunk? One should also endeavor to determine whether the condition is inflammatory or mechanical or malignant.

From a causative standpoint backaches may be classified as (1) arthritic, (2) traumatic, (3) static or postural, (4) pelvic or as resulting from other abdominal reflex conditions.

Arthritic type.—The author quotes from a study of 137 cases reviewed by Carter from the records of the Bigelow Clinic. In this series the most frequent cause of backache was found to be arthritis, either primarily spinal or as a part of a generalized osteoarthritis. Foci of infection considered causative for this arthritis were the tonsils, abscessed roots of teeth, infected antra, and pyelonephritis. Prostatic infection was occasionally found. Intestinal stasis was found very frequently and was regarded as a causative factor.

Traumatic type.—Backache due to trauma and not associated with arthritis is usually due to such injuries as fracture of the vertebral body or of the transverse process, or the strain of spinal muscles or ligaments. Traumatic spondylolisthesis occurred only rarely. A common type of traumatic backache is found in some post-operative cases where dorsal recumbency is enforced in the case of a previously active individual. To obviate or relieve this a suitable lumbar pad should be used to support the normal lumbar curve.

Pelvic and reflex.—Uterine retroversion, pelvic varicocele, pelvic tumor, pelvic congestion at the menstrual period, and pelvic inflammation are frequently met with as causative factors in low backache. Bi-manual pelvic examination will clear up the diagnosis in the uncomplicated cases. Occasionally one finds such coincident conditions as pyelonephritis, perinephritic abscess, floating kidney, or ureteral kink or calculi.

Static or postural type.—This may be due to definite orthopedic faults or to a combination of such. Any variation from the normal upright posture, especially under the strain of work, produces muscle and ligamentous strain complained of as backache. Examples of faulty posture, in which the poise of the body is thrown off its center of gravity over its base, are round shoulders, lordosis, and flat back. Pendulous abdomens and consequently hollow backs and marked increase of the normal inclination of the pelvis are common causes of tenderness over the sacral and sacro-iliac regions.

Treatment.—When the pain is acute, bed is the proper treatment; it is the splint which immobilizes the back in the non-weight-bearing position. This form of treatment is essential in the arthritic type. The bed must be rigid and without sag. The normal lumbar curve must be supported by a suitably shaped lumbar pad. When all inflammatory periarticular exudate has been absorbed and muscle spasm has been relaxed, which may be a matter of ten days to three weeks, some retentive or supporting apparatus should be applied.

Any existing foci of infection must be eliminated, and, if possible, autogenous vaccines administered.

Postural defects must receive the appropriate treatment.

The general health must be cared for and a régime of good hygiene instituted.

L. J. CARTER, M.D.

Backache. H. S. Sharpe. *Canadian Med. Assn. Jour.*, Nov., 1925, p. 1131.

Control of the tuberculous.—In this article the author discusses the migratory habits of men and women infected with pulmonary tuberculosis as a means of spreading infection. Frequently sufferers from tuberculosis in a chronic form reside in private houses which have apartments to let. When such a sufferer has vacated such an apartment, the apartment is most often not subjected to disinfection. The rooms may then be rented for occupancy by a person of lowered

resistance, and the infection is readily taken up in the new habitat.

The writer contends that control over tuberculous patients is always irregular and uncertain, and cites numerous examples. This lack of individual control is stressed as a contributory factor in the rapid spread of pulmonary tuberculosis.

As a solution of this difficulty the author advances the following suggestions: (1) Thorough disinfection. (2) Supervision of a definite nature over tuberculous patients while they are at large. This applies particularly to those deficient in (a) education or (b) sense of moral responsibility. (3) Perfection of system of tuberculosis notification and the keeping of definite tuberculosis register. (4) This notification to be made a legal obligation resting on the patient. (5) More definite methods and principles of segregation.

B. C. CUSHWAY, M.D.

The Danger of Tuberculous Infection from Migratory Consumptives. W. Bolton Tomson. *Brit. Jour. Tuberc.*, Oct., 1925, p. 196.

Effect of roentgen rays on oxydasis.—The oxydase reaction, one of the best known ferment reactions in the organism, was studied by the authors using the indophenol blue test as given by Graeff. The heart, skeletal muscles, diaphragm, testicle, skin, and leukocytes of guinea pigs were used in the experiments and exposed to the dose of 36,000 Roentgen (600 S.U.D.) unfiltered radiation *in vitro*; controls were made by treating the living animal with the same dose. No change of the stable and labile oxydasis could be detected. It seems, therefore, that X-rays do not affect the oxydasis in cells.

E. A. POHLE, M.D.

The Effect of Roentgen Rays on Indophenol Blue Oxydasis in Tissues and Leukocytes. S. Hallheimer and H. R. Schinz. *Strahlentherapie*, 1925, XX, 331.

Athreptic infants.—Premature, toxic, and typically athreptic infants display symptoms of peritoneal injury in a manner that may be termed static. One patient showed infection through the umbilical vein. In intussusception in the athreptic infant, pain, tumor and vomiting may be seen only late in the disease, and diagnosis may be difficult. Even slight distention, not reducible by enemas, in emaciated infants, should be a contra-indication for intra-peritoneal instillation of salt solution or blood. A gain of weight after this procedure in desperately ill athreptic infants means a non-absorbing peritoneum.

Usually, by the time it is possible to establish the diagnosis with certainty, treatment is unavailing. Hence the need for prophylaxis of athrepsia by breast milk feeding and care as to the hygiene of the infant in the first weeks of life.

The use of pituitary extract to promote peristalsis in young infants is fraught with danger, since it readily produces intussusception.

W. W. WASSON, M.D.

Static Peritonitis in the Mal-nourished Infant: Report of Cases. John A. Foote. *Jour. Am. Med. Assn.*, Sept. 5, 1925, p. 720.

Radium technic and the theory of cell stimulation.—Among certain internists and surgeons, confusion exists as to the relative merits of X-rays and radium in the treatment of certain conditions. Radium placed at the skin surface and calculated so as to give a maximum 100 per cent dose at 0.5 cm. from the skin, will give only 25 per cent dose at 1 cm. distance. Now if the distance between the radium and the skin is increased to 2.5 cm., here the time to deliver a full dose to the skin is much longer and, of course, much more expensive. The effective dose, 2.5 cm. beneath the skin (5 cm. from radium), is only 25 per cent of that at the skin surface. It will be seen from this that radium is best used as a purely local agent. If a lesion is large, or if, as in many malignant growths, its shape is irregular and its extent ill-defined, and especially if it is below the surface, radium is not the agent of choice—X-ray is to be preferred. In many cases the combined use of radium and X-ray is most desirable, as on carcinoma of the cervix of the uterus.

The statement that radium or X-ray can stimulate cells is often expressed or implied. No one, however, has ever brought forward the slightest evidence in favor of the theory of stimulation in the sense of continued acceleration of cell life. All stages of skin and tumor reaction after exposure to radiation indicate a destructive action. A mass of evidence exists tending to show that the major factor in the effect of X-rays or radium is a direct one.

L. R. SANTE, M.D.

Common Misconceptions in Radiotherapy. Arthur U. Desjardins. *Surg., Gynec. and Obst.*, Jan., 1926, p. 64.

Energy input and output of mercury vapor lamps.—The watt input and the emitted ultra-violet radiation of mercury vapor lamps during the first thirty minutes after lighting the burner were carefully measured, using a power meter and a thermopile, respectively. Considerable fluctuation could be demonstrated when re-

lighting the lamp if the power had been switched off and then turned on again after an interval of from one-half to ten minutes. It proved that the length of the interval has a direct bearing on the time required to return to normal intensity. The author emphasizes the fact that the dosage is, therefore, most difficult during the first minutes after re-lighting the mercury lamp, and suggests that corrections be made, based on exact measurements, or that the lamp be left burning between treatments.

E. A. POHLE, M.D.

Fluctuation of the Watt Input and Emitted Intensity of Lamps, Especially Mercury Vapor Lamps. C. B. Hoernicke. *Strahlentherapie*, 1925, Vol. 20, p. 664.

Dercum's disease. — The case of adiposis dolorosa reported in this paper was quite typical clinically. Pathologically, there was enlargement of the sella turcica, with an adenomatous growth in the pituitary, recent petechial hemorrhages in the region of the third ventricle, and adenoma of the left suprarenal, and atrophic ovaries. The theory of endocrine malfunction seems best suited to explain the symptoms in this case.

W. W. WASSON, M.D.

Adiposis Dolorosa (Dercum's Disease): A Clinicopathological Study. N. W. Winkelman and John L. Eckel. *Jour. Am. Med. Assn.*, Dec. 19, 1925, p. 1935.

Congenital malformation of ear. — This paper deals, first, with a rather brief summary of the anatomy of the ear in relation to the congenital malformation, as follows: (a) the external ear; (b) middle ear; (c) mastoid; (d) internal ear; (e) neighboring structures.

The external ear may be entirely wanting, including obliteration of the external canal, or there may be only slight defect in the pinna of the ear. All possible degrees and varieties of deformity may exist between these two extremes. The writer emphasizes the value of the X-ray as a determining factor as to whether or not a middle ear exists in these cases. Roentgen examination is invaluable as a diagnostic procedure. The method is that of catheter inflation and the X-ray of a bougie in place. The X-ray also takes a paramount place in the determination of the degree of pneumatization of the mastoid directly affected, the integrity of the ear as a sound-referring apparatus, and as a sound-perceiving organ. Cases are referred to in which the congenital deformity of the external ear was associated with a non-functioning labyrinth, where there was not the least evidence of mas-

toid pneumatic cells and the internal auditory meatus was not outlined. Conversely, in these cases of deformed ears in which the hearing was good or at least fair, the pneumatization of the mastoid was marked. Here again the X-ray must be resorted to as a revealing diagnostic factor.

The treatment referred to in this article is largely that of surgical application for cosmetic effect.

B. C. CUSHWAY, M.D.

The Anatomy, Psychology, Diagnosis and Treatment of Congenital Malformation and Absence of the Ear. Joseph C. Beck. *Laryngoscope*, Nov., 1925, p. 813.

Illustration of proper time for roentgen examination.—This article is chiefly a case report, with references to the literature. The case is one of extensive progressive osteomyelitis of the frontal bone with pneumococcus as the offending organism. The disease followed very mild trauma. A number of roentgenograms are shown, depicting the progress of the disease. Of interest to the roentgenologist is the fact that an incision was made into the orbit under the impression that the infection was localized there and prior to the making of any roentgen examination. Apparently the patient would have been brought under efficient treatment somewhat more promptly had the roentgen examination been made first.

CHARLES D. ENFIELD, M.D.

Osteomyelitis of the Frontal Bone as a Complication of Frontal Sinusitis. Albert E. Bulson, Jr. *Jour. Am. Med. Assn.*, Jan. 23, 1926, p. 246.

Fractures.—Ordinarily fractures are reduced by open operation only when they cannot be replaced in fairly satisfactory position by ordinary means. In spite of all efforts, under certain circumstances, the surgeon frequently has to be satisfied with partial reduction. To determine the end-results in this class the following study of 200 cases was undertaken. Of these, 176 patients were under the age of 15 years, the study having been made to determine the end-results of imperfect anatomical reduction of fracture of the forearm.

1. In children, a good result may be expected even when a perfect reduction has not been obtained, since there is much subsequent improvement as the bone growth proceeds.

2. In children, complete fracture is more frequent than the greenstick variety when both bones of the forearm are involved.

3. In adults, there is very little tendency to overcome deformity following imperfect reduction.

4. Following indirect injury or trauma, fracture of both bones is to be expected rather than epiphyseal separation.

5. When both bones of the forearm are fractured, the fracture occurs in the lower two-thirds in 90 per cent of the cases.

6. Before bony growth is completed a closed reduction is preferable to an open one, even though perfect alignment of the fragments cannot be obtained.

L. R. SANTE, M.D.

Fracture of Both Bones of the Forearm. Cecil H. Bagley. Surg., Gynec. and Obst., Jan., 1926, p. 95.

Roentgen therapy of laryngeal tuberculosis.—The author discusses the modern treatment of laryngeal tuberculosis. He points out that, besides the local therapy, an effort is to be made to influence the whole organism. Body hygiene, tonics, fresh air, and heliotherapy are factors to be considered. The technic for roentgen treatment is as follows: No spark gap is given; 2 to 2½ ma.; 24 cm. F.S.D.; 4 mm. Al.; 3 round fields, 4 to 6 cm. diameter, probably over the left and right sides and anterior larynx; 6 to 10 X on each field (about 15–20 per cent S.U.D.). Three treatments are given every second day, followed by a three-week interval. The dose may be repeated. Radium is not recommended.

E. A. POHLE, M.D.

The Modern Treatment of Tuberculosis of the Larynx, with Special Consideration of Roentgen Therapy. L. Rickmann. Strahlentherapie, 1925, XX, 291.

Skin cancer.—The authors state that from the time of its opening in 1915 to the end of 1921, 160 cases of skin cancer have been treated at the Antoni van Leeuwenhoek Hospital at Amsterdam, not including 16 cases in which the cancer developed in lupus. The disease mostly occurred at an advanced age. Only 15 patients, or about 9 per cent, were under fifty, and 69, or about 43 per cent, were over seventy. Of the 160 patients, 65 had been treated previously elsewhere, the treatment having consisted of one or more operations, irradiation by X-rays, radium or mesothorium, caustics, or a combination of two or more of these methods.

The patients were classified in three groups. The first group consisted of cases in which there was little overgrowth of tissue but ulceration was the prominent feature; the second

group was characterized by exuberant exophytic growth, and in the third group the growth showed a tendency to extend down into the depth of the tissues.

The treatment employed by the present authors consisted in the application of radium after removal with a sharp spoon of the exophytic masses characteristic of the second group. The results were as follows: 44 patients who had been treated elsewhere were admitted with a recurrence—of these, 27, or about 61 per cent, were cured, and 17 died. On the other hand, of 116 patients who had received no previous treatment 104, or about 89 per cent, were cured.

The authors come to the following conclusions: (1) Every hitherto untreated skin cancer which is not inaccessible to radium and is not accompanied by metastases can be cured by radium according to the authors' method. (2) The 25 recurrences which took place among the cases treated by them were cured, with one exception. (3) Of the recurrences among those treated elsewhere, about 60 per cent could be cured. (4) Radium treatment of skin cancer is preferable to excision, even in cases in which this can be carried out without causing deformity. Radium is not suitable for cases in which metastases have taken place.

Carcinoma of the Skin. W. F. Wassink and C. P. Wassink-van Raamsdouw. Nederl. Tijdschr. v. Geneesk., Sept. 17, 1925, p. 1333. (Reprinted by permission from the Brit. Med. Jour., Dec. 26, 1925, p. 96 of Epitome of Current Medical Literature.)

Cancer of larynx.—The author thinks that frequency of prolapse of the ventricle of Morgagni in men partly explains the comparative rarity of intrinsic cancer of the larynx in women. He concludes, however, that no hypothesis so far is based on sufficient grounds to assist in determining the etiology or the treatment. He insists on the necessity of very careful diagnosis from clinical observation and biopsy, as the results of histological examination are not always reliable. He regards laryngo-fissure as the operation of choice in doubtful cases, since it does not destroy any function of the larynx, is a good method if the growth should be benign or of the squamous variety of cancer, and enables an accurate diagnosis to be made. Should the growth be of the cylindrical celled variety, which is more malignant, total laryngectomy is still possible. No differences of technic in treating male and female patients have yet been formulated, and laryngologists are still in great doubt as to the best methods.

In the light of present knowledge, Ferreri favors the use of radium. Intensive and deep

radiotherapy must be applied with caution, as in some cases an exacerbation of malignancy may take place or toxic absorption may be increased. So many patients refuse the mutilating operation of laryngectomy that tracheotomy and therapeutic measures are the only ones available. He adds that since the resistance of the cells of women to X-rays is less than that of men, this treatment is more dangerous in women. Radium can be applied by passing the tube through the mouth into the larynx, or by incorporating the radium carrier in an O'Dwyer tube. Radium can also be applied from a tracheotomy wound, but in some sub-glottic cases a laryngo-fissure is necessary.

Laryngeal Carcinoma. G. Ferreri. Arch. Internat. de Laryngol., Otol. et Rhinol., Sept.-Oct., 1925, p. 897. (Reprinted by permission from the Brit. Med. Jour., Dec. 26, 1925, p. 95 of Epitome of Current Medical Literature.)

Radium effect on oxidation in cells.—The oxidation and reduction of iron in the cells of the leaf of the white lily were studied before and after radium radiation, using a modification of Macallum's method as a microchemical test. The author concludes that the chromatic substance of the nucleus is the center for the oxidation and reduction process. The difference in the staining of chromatic particles is evidently due to a varying iron valence, which, in its turn, is a function of the vitality of the cell. The radium effect is shown by reduction processes in the nucleus, followed by the formation of higher oxidation products in the cell; a very heavy dose will lead to destruction.

E. A. POHLE, M.D.

The Problem of Cell Metabolism. I. The Effect of Radium Rays on Oxidation in the Cell. N. S. Kondratjew. Strahlentherapie, 1925, Vol. 20, p. 771.

Causes and treatment of non-union.—Fractures produced by direct injury, whether simple or compound, in which the trauma is sufficient really to injure and devitalize the tissues, are more prone to remain ununited than are those in which the trauma is not so severe. Usually the trauma is most severe with compound fractures; this was true in the cases of this series, and accordingly there were more cases of non-union than delayed union with this type of compound injury. General systemic conditions were negative from clinical study alone. Local causes are far more significant in the development of ununited fractures than general or systemic causes, but the chemical analy-

sis of the blood to determine the calcium and phosphorus content was suggestive in a small number of cases. This test is a delicate one, and abnormal readings must be carefully checked by further tests before being accepted. If the calcium and phosphorus content of the blood serum could be raised above normal for any length of time, it is possible that, in cases of delayed union, union might be induced, but cases of fixed non-union would probably not be benefited.

The bone graft is of the greatest service, and without it, it would not be possible to obtain cures in 93 per cent of delayed union, and in 82.6 per cent of non-union, or in 86.4 per cent of cases of ununited fracture when the two are grouped together. The bones in cases of delayed union are more easily induced to unite than in cases of non-union, as shown by the fact that with the plastic type of operation there were 93 per cent of cures in cases of delayed union, whereas in cases of non-union there were only 65 per cent of cures. The distinction between delayed union and non-union should be borne in mind in treating ununited fractures. In this series, certain fractures were considered as delayed unions one and one-half years after the accident, whereas others in the hip were considered as non-unions after three months, and in certain fractures of the shaft after four months. The average duration of the non-unions before operation was two years. By recognizing this difference, and by putting forth greater effort and more care in the planning and execution of operations for non-union, a higher percentage of cures has been obtained than heretofore.

W. W. WASSON, M.D.

Ununited Fractures. Melvin S. Henderson. Jour. Am. Med. Assn., Jan. 9, 1926, p. 81.

Tumors of the urinary bladder.—Dr. Ferrier attempts to evaluate the various procedures in the treatment of tumors of the urinary bladder. Papillomas should be fulgurated; malignant papillomas should be given a trial with fulguration and radium implantation; those which do not respond to the above treatment, those around the bladder neck, those of uncontrollable bleeding, and those intolerant of the cystoscope should be treated by operation. Multiple cancers confined to the bladder, especially if they involve the sphincter, call for total cystectomy. Radium alone, implanted through the cystoscope, has had many apparent cures and in the hands of those who are prepared to implant it throughout the growth, it is worthy of further trial. Deep X-ray therapy should be used in every case of malignancy. Experience

does not show that it can take the place of local treatment, but the local treatments have shown better results when supplemented with X-ray. Large cancers, having a reasonable amount of normal bladder, sphincter and one meatus, should be treated by diathermy, the implantation of radium needles, screened radium topically, supplemented by deep X-ray therapy. The author believes this to be the greatest recent advance in the treatment of extensive cancer of the bladder.

F. B. SHELDON, M.D.

Some Problems in the Management of Tumors of the Urinary Bladder. Paul A. Ferrier. *Calif. and West. Med.*, Oct., 1925, p. 1303.

Non-surgical treatment of bone and joint tuberculosis.—Kisch, a co-worker of A. Bier, of Berlin, presents in this paper his wide experience in bone and joint tuberculosis. In a sanatorium near Berlin patients of this type were greatly benefited by a combined therapy, with fresh air, diet, and local hyperemia; ultra-violet radiation was also used. The exact technic of the procedure is given. A well chosen series of gymnastic exercises are taken by every patient as soon as his condition permits. The results were excellent, the percentage of necessary resections being very small. This proves that it is feasible to do heliotherapy in low altitudes; on foggy days, lamps can supplement the required radiation.

E. A. POHLE, M.D.

The Non-surgical Treatment of Bone and Joint Tuberculosis. E. Kisch. *Strahlentherapie*, 1925, Vol. 20, p. 499.

Diaphragmatic hernia.—The author records an unusual case of diaphragmatic hernia in a child, apparently cured by a simple operative procedure. The patient, a girl aged two and a half years, had the symptoms of a left-sided pleurisy simulating a pyo-pneumothorax, but without any elevation of temperature. This was confirmed by the clinical signs present. Radiography showed what appeared to be free fluid in the thorax with an extensive pneumothorax above it. To confirm or modify the diagnosis the child was given a bismuth meal, which was easily followed down the esophagus into the abnormal pocket, the remainder of the meal passing on into the stomach. The diagnosis of a transdiaphragmatic hernia of the stomach was then made.

The difficulty of treatment and the severity of a transthoracic operation were explained to the parents, who at first refused operation. Later, as the child's condition became worse, with

marked vomiting, emaciation, and severe epigastric pain, it was decided to try the palliative effect of a simple gastrostomy, to enable the child to take nourishment and to improve her condition for a more radical operation at a later date. Under general anesthesia a laparotomy was performed and the stomach was drawn down as far as possible into the abdomen. When as much of the organ as possible had come down, the stomach was fixed and a gastrostomy performed. The post-operative course was uneventful. Radiograms showed that none of the stomach had returned above the diaphragm and the reduction of the hernia appeared permanent. The cardiac orifice returned to its normal position.

The author considers that the case is of exceptional interest as showing how such a satisfactory result was obtained by a very simple operation.

Diaphragmatic Hernia in a Child Cured by Gastrostomy. J. Abadie. *Bull. et Mém. Soc. Nat. de Chir.*, Oct. 24, 1925, p. 868. (Reprinted by permission from the *Brit. Med. Jour.*, Dec. 5, 1925, p. 84 of *Epitome of Current Medical Literature.*)

Toxicity of dyes in functional tests.—Following the use of phenoltetrachlorphthalein, thromboses, local inflammatory reactions at the site of injection, and chills have been encountered by many observers. Several deaths probably due to its use have been reported. Clinical and experimental work indicates the possibility of strain or damage to the liver, following injection of the dye. Attempts to make phenoltetrachlorphthalein non-irritating on injection have failed. Many observers have noticed severe toxic reactions following the use of tetrabromphenolphthalein and tetraiodophenolphthalein. The toxicity of the halogenated phthalein compounds should lead to caution in their use. Indiscriminate administration and overdosage should be avoided.

W. W. WASSON, M.D.

Dangers in the Use of Certain Halogenated Phthaleins as Functional Tests. W. H. Rosenau. *Jour. Am. Med. Assn.*, Dec. 26, 1925, p. 2017.

Conclusions from Breast Clinic at Memorial Hospital, New York.—Three hundred and sixty-three cases of inoperable and recurrent cancer of the breast were treated at the Breast Clinic of the Memorial Hospital prior to May 1, 1922. The material in this article is based on a study of these cases. The methods of treatment included low voltage roentgen rays in most cases, high voltage roentgen rays in a few cases,

and radium either in the form of pack, tray, needles or embedded emanation, in some cases. The authors state they have seen no ill effects from administration over the same areas of rather full doses of X-ray and radium. Embedded emanation tubes proved unsatisfactory and apt to cause ulceration, neuritis and other undesirable complications. Electrocoagulation was used in a few cases.

The article does not lend itself to abstracting, as it incorporates a large number of tables and statistical data. The following conclusions were reached: First, a careful selection of patients for operation should be made as a prophylaxis against the recurrence of breast carcinoma (this is a commentary on the fact that many of the cases here reported showed recurrence so promptly that the authors concluded that metastasis must have been already present at the time of operation); second, pre-operative and post-operative cycles of roentgen ray are important prophylactic measures against recurrence; third, carefully planned and properly applied irradiation to recurrent breast carcinoma definitely prolongs the life of the patient and may control the disease for a considerable period of years.

CHARLES D. ENFIELD, M.D.

Recurrent Inoperable Carcinoma of the Breast.
Burton J. Lee and Norman E. Tannenbaum.
Jour. Am. Med. Assn., Jan. 23, 1926, p. 250.

Case of congenital cardiac hypertrophy.—

Twenty cases were collected and reported by Howland in 1919, and another case has been reported by Carrington and Krumbhaar. The authors present the report of a case of a similar nature. The patient, age five weeks, was referred primarily for gastro-intestinal disturbance, dyspnea and cyanosis. She was a normal delivery, weighing 8 pounds 2 ounces at birth. June 8 she had her first attack of dyspnea, followed by a second attack two days later. Seen by the authors next day, a diagnosis of congenital heart defect was made because of cyanosis, dyspnea and enlarged liver. June 23 the infant started to vomit, respiration became of grunting type, she became cyanotic again. Lungs were clear, but heart dullness was markedly enlarged; no murmurs were heard. The roentgenogram showed that the heart was enlarged to the right, the liver was enlarged, but there was no enlargement of the thymus. The infant died, and at necropsy the heart was found to weigh 55.4 gm., and was 6.5 cm. wide. There was marked hypertrophy of the ventricular musculature.

SUMMARY

The normal weight for a heart in the second month is 19.6 gm. This heart was similar to that of an infant aged eighteen months. There

is no etiology to explain this condition other than that it is congenital. The symptomatology is not marked, except for the rapid respirations, or dyspnea in the late stages of the condition.

In the case of the authors' patient, at the first examination they did not note any increase in the cardiac outline, which was later very evident, due probably to acute dilatation. The roentgenogram and necropsy findings showed that the heart must have been enlarged all the time, but dilated antemortem. The liver changes were due to passive congestion, which also caused the digestive disturbances and cyanosis. The necropsy findings showed no nephritis.

L. R. SANTE, M.D.

Congenital Cardiac Hypertrophy: Case Report. A. J. Scott, Jr., and A. H. Zeiler. *Am. Jour. Dis. Child., Jan., 1926, p. 31.*

Radiation effect on colloids in cells.—A number of *Protozoa* (*Amæba* and *Spirochæta*) were subjected to filtered radium radiation in order to study its influence, particularly on colloids of the cells. The authors come to the interesting conclusion that there is a marked effect manifesting itself by a thinning of the cell content. It is also proved that a cell is the more susceptible to the gamma rays, the thinner its colloids are, i.e., the greater its dispersity is, and that it has the characteristics of a sol. Under normal conditions cells undergoing mitosis have these properties and this may explain, for instance, the high sensibility of the ovaries and testicles because a continuous regeneration is taking place in these organs. In practice, the question comes up how to define the colloidal state of tumor cells and how to increase their dispersity to render them more sensitive to radiation.

E. A. POHLE, M.D.

The Influence of Radium Radiation upon the Cell Content of Protozoa. M. Zuelzer and E. Philipp. *Strahlentherapie, 1925, Vol. 20, p. 737.*

Diverticula of the duodenum.—The author points out that diverticula of the duodenum are rare. The earliest recorded cases were found after death; later, they were noted during the course of operation, and finally they were recognized by the radiologist. Their usual situation appears to be in the first part of the duodenum, or they may be found towards the termination of the second part; occasionally the condition has been found at the end of the duodenum, where it may penetrate the substance of the pancreas.

The symptoms produced by this condition are usually those of an ulcer near the pylorus, and

there may also be signs of obstruction to the common bile duct. The diagnosis generally made is that of pyloric ulcer, or of biliary or pancreatic calculus. The diverticulum may be found associated with a duodenal ulcer.

The treatment may consist in excision of the diverticulum, followed by suture and invagination, accompanied by a gastro-enterostomy; many successes have followed this treatment. Pérard, however, records a case treated by duodeno-pylorotomy in which the patient died from peritonitis seven days after the operation. In most of the recorded cases the simpler operation of local excision appears to have been practised, and to have given better results than the more radical procedure.

Duodenal Diverticula. C. Pérard. *Bull. et Mém. Soc. Nat. de Chir.*, Nov. 7, 1925, p. 920. (Reprinted by permission from the *Brit. Med. Jour.*, Dec. 26, 1925, p. 96 of *Epitome of Current Medical Literature.*)

Treatment of acne vulgaris.—For convenience and purposes of his discussion, Dr. Stratton presents acne under three group headings: Group I includes juvenile, or the most common form of acne vulgaris; Group II, artificial acnes, caused by both internal and external irritations, such as the ingestion of iodides or bromides, or the local application of oils, tar, etc., and Group III, acnes of obscure etiology, which do not respond satisfactorily to local treatment, and which occur, as a rule, in individuals over 25 years of age. Juvenile acne comprises some 8 per cent of all skin lesions. The treatment of this type should first be directed to the correction of constitutional disturbance such as habitual constipation, dyspepsia, improper diet, which may play an equal part with the skin condition. On the whole, relief depends on the local treatment. The first step is to get rid of the pustules and subcutaneous abscesses, best done by incising and hygroscopic wet dressings. The author believes that vaccine therapy is an aid in clearing up the pus. After the pustules disappear there still remain papules, comedones, and a thickened skin to deal with. Therefore the next indication is to get rid of the thickened skin: this is accomplished by peeling. There are many remedies for this purpose. After the peeling the skin is ready for X-ray therapy and a surprisingly small quantity is needed to clear up the papules after the skin is first prepared as indicated. The author's method is to begin with a 10 per cent erythema dose and give five weekly treatments, increasing the dose 5 per cent each week. This has been found a safe method of treatment and should the trouble prove recal-

citrant the roentgen treatment may be repeated after an interval of two weeks.

Artificial acnes are treated by removal of the cause and the use of soothing pastes. Group III cases have been found not to present a classical picture of acne and after the removal of focal infections many have cleared up immediately when other vigorous treatment had no effect.

F. B. SHELDON, M.D.

Treatment of Acne Vulgaris. Ernest K. Stratton. *Calif. and West. Med.*, Oct., 1925, p. 1301.

Charcot joints.—In 1907, Barker reported 400 cases of Charcot joints; since then a goodly number have been reported so that the authors judge that well over 500 cases are covered in the literature. Almost any joints may be affected, but those most frequently involved are the knees, hips, and shoulders. Bilateral involvement does occur but it is relatively rare. Flatow reported 13 cases where there was bilateral knee involvement and 9 cases of bilateral hip involvement. Henderson's study of 333 cases showed bilateral hip involvement in 24 instances. The authors add 3 cases of bilateral hip involvement, with case reports. One of these is of exceptional interest in that the patient was very young,—14 years of age at the time of onset of the disease. Juvenile tabes is very rare; associated with Charcot joint it is even rarer and with bilateral Charcot involvement it is rarer still.

L. R. SANTE, M.D.

Bilateral Charcot Hip Joints: Report of Three Cases. James L. Greene and Francis J. Scully. *Am. Jour. Syph.*, Oct., 1925, p. 704.

X-ray and organotherapy of ovarian diseases.—The problem of influencing any ovarian disease therapeutically is very complicated, as the ovaries do not function as the other glands of internal secretion, continuously, but periodically. The effect of organo-therapy is corrective, but, in all probability, unspecific, because extracts of other glands and organs, or protein preparations, lead to the same result. Discussing the etiology of menorrhagia, climacteric affections, and osteomalacia, which are supposed to be due to ovarian disturbances, the author concludes that there is no true hyperfunction of the ovaries; none of the mentioned conditions can be caused, experimentally, by injection of ovarian extracts. X-ray therapy, therefore, can not have a reducing action upon the ovaries, as in the treatment of hyperthyroidism, but the mechanism of the therapeutic effect is very likely to be an elimination of certain ovarian cells, ac-

cording to their degree of vitality or functional stage, which renders them more or less sensitive to roentgen rays. On this basis, the following doses on the ovary are recommended: For amenorrhea, 5 to 10 per cent; for osteomalacia, 10 to 15 per cent; for bleeding as a reducing means, 15 to 25 per cent; for sterilization, 25 to 50 per cent (S.U.D.), depending upon the age. The effect of spleen and liver extract on uterine bleeding is explained by an increased tonus of the vessels, a greater coagulation power of the blood, and a direct action upon the ovaries. The same result may be obtained by irradiating these organs. The relations between hypophysis and ovaries are briefly mentioned, also X-ray treatment of these glands in cases of fibromyoma of the uterus as inaugurated by Hofbauer. This problem will be discussed in a third article.

E. A. POHLE, M.D.

The X-ray and Organotherapy in Inner Secretory Disturbances. Part II, The Ovaries. J. Borak. Strahlentherapie, 1925, Vol. 20, p. 441.

Calcification of subcutaneous tissue.—The presence of multiple calcified plaques in the subcutaneous tissue of children is a rare process, and the few cases studied are so strikingly similar as to constitute a rather definite clinical and pathological entity. Pathologically the presence of lime-salt aggregations is the end-result of a chronic disease process in which the original cause can no longer be identified. It seems to be fairly well established that the condition occurs in calcification of fat necrosis. The rareness of the condition and the probable evidence of having no association with previous fat necrosis have influenced the authors to report this case.

A boy, age five years, admitted to hospital because of painful knee and multiple subcutaneous nodules. Nothing of significance was noted in past history or in history of previous ossification. The present illness dated back two and a half years before this examination, when the mother noticed that the boy became weak and unsteady and dropped to his knees when he walked. About six months later several small painless swellings appeared under the skin over the crests of both tibiae. These were freely movable. Similar nodules developed later at many other places. The skin became red over one of these areas, indurated, and ulcerated, with extrusion of chalky material and pus. This was followed by healing of the wound. These tumor-like swellings ranged in size from 0.5 to 3 or 4 cm. in the longest diameter, and their appearance was attended with all signs of inflamma-

tion. The skin was rough and dry. There was no evidence of glandular metastases. Chemical analysis of these nodules revealed their composition to be calcium salts. Microscopically, the lime-salt deposit was found to be in the subcutaneous layers surrounded by fibrous and adipose tissue. The blood vessels of the involved region were thickened and in some places obliterated. There was no evidence of fat necrosis. These changes are accredited by the authors to definite local physiochemical changes in the tissue.

L. R. SANTE, M.D.

Calcification of Subcutaneous Tissue in a Child (Calcinosis Universalis). Gustav Wilens and Joseph Derby. Am. Jour. Dis. Child., Jan., 1926, p. 34.

Neuro-arthropathies.—In the light of the facts heretofore presented, it is the opinion of the writers that neuro-arthropathies caused by peripheral nerve injury or other factors not definitely understood occur with more frequency than is usually believed. It is their opinion that these neuro-arthropathies are possibly misinterpreted on account of the absence of demonstrable disease of the central nervous system. In the wake of such misinterpretation, extensive joint operations may be performed unnecessarily, as in a case cited. The possibility of neuro-arthropathy should always be considered in obscure or ill-defined joint manifestations, even in the absence of cord disease. The etiology may be found in disturbances of the peripheral neural apparatus or other hitherto unknown factors.

W. W. WASSON, M.D.

Neuro-arthropathies of Peripheral Nerve Injury Origin: Report of Two Cases. Herman B. Philips and Charles Rosenheck. Jour. Am. Med. Assn., Jan. 16, 1926, p. 169.

Variations in the normal sella.—Observations based on anatomic specimens and roentgenograms show the normal sella to vary in contour and size. Variations in contour may be classed under three types: the round, oval and flat, of which the oval type predominates in the adult. The average sella will measure 1.06 cm. and 0.81 cm. in the anteroposterior and vertical directions, respectively. Variations in the shape of the clinoid processes are numerous, and union between the anterior, middle and posterior clinoids, producing a bridged sella, occurs in about 5 per cent of cases. Such an anatomic variation seems to be of no clinical significance.

Pseudo-defects and apparent anomalies of structure are easily produced in a roentgenogram by faulty localizing technic.

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Pathologic conditions producing changes in the sella are numerous, and the differentiation of these changes as to cause is often difficult. Owing to the characteristic deformity of the sella usually produced by each, the differentiation between an intrasellar and an extrasellar lesion is generally possible.

W. W. WASSON, M.D.

The Sella Turcica: The Significance of Changes in its Roentgenographic Appearance. John D. Camp. *Jour. Am. Med. Assn.*, Jan. 16, 1926, p. 164.

Roentgen-ray effect on cholesterin.—The authors have published in a former paper (*Strahlentherapie*, 1925, Vol. 19, p. 541) the results of experiments as to the effect of roentgen rays on cholesterin *in vitro*. They have continued this research and undertaken an elementary analysis of the product formed. It seems that the action of the roentgen rays leads to an oxidation which produces an acid effect. This process must start from the carbon atom.

E. A. POHLE, M.D.

Changes Taking Place in Cholesterin after X-ray Radiation. A. H. Roffo and L. M. Correa. *Strahlentherapie*, 1925, Vol. 20, p. 574.

Rickets.—In previous studies on rickets, it has been accepted without proof that the disease causes delay in ossification of bones and in the appearance of ossification centers. The present study, made on 350 children, utilizes not only chemical examination of blood but also routine monthly radiographs to detect the first appearance of the carpal ossification centers. Only infants in which no ossification center was present at first examination, were used. These were 62 in number—40 of these had rickets,—22 were normal.

The changes observed in the epiphyses and centers of ossification in rickets are similar to those in the shafts of the long bones. The density of the shadow is decreased evenly throughout, and in the very severe cases rarefaction is so pronounced that the center appears completely washed or punched out—an empty body often mistaken for an artefact, a ring which has lost its normal sharp outline. In severe rickets, centers which were previously visible may become invisible as a result of the calcium poverty. This phenomenon was observed in two instances.

When healing begins it proceeds rapidly and is attended by a restoration of the process of calcium deposition. Roentgenographically, the change is seen by a sharper demarkation between bones and soft tissue due to a calcification of

the cortex, and an increasing intensity of the shadow. The more vigorous the tendency to heal, the quicker does the intensity and size of the shadow increase. The most definite indication of calcification is the appearance of a finely etched periosteal margin, sharply distinguished from the shadow of the ossification center itself.

SUMMARY AND CONCLUSIONS

The appearance of carpal centers in infants with rickets was later than in infants free from rickets. Twenty-two of the forty infants with rickets (or 55 per cent) developed their first center during the first six months of life, whereas eighteen of the twenty-two infants free from rickets (or 82 per cent) developed carpal centers during a corresponding period.

The development of second or subsequent carpal centers in infants with rickets was delayed, compared to their appearance when rickets was absent. Five of the infants with rickets (or 12.5 per cent) developed second or subsequent carpal centers within the first six months of life, whereas seven of the infants free from rickets (or 32 per cent) developed them during the corresponding period.

The development of more than two carpal centers during the first six months of life was retarded in rachitic infants compared to non-rachitic infants. None of the infants with rickets had more than two carpal centers, whereas two of those free from rickets had three carpal centers or a radial center.

Although delayed, new calcification centers appeared during the active stages of rickets. Thirty-three (or 82 per cent) of the infants with rickets showed new calcification centers during the active stages of the disease.

Antirachitic treatment (cod liver oil, ultra-violet rays or yolk of egg) rarely brought about a development of carpal centers within a period of two months.

L. R. SANTE, M.D.

Is the Development of the Carpal Centers Delayed in Rickets? I. H. Goldberger and J. Mellon. *Am. Jour. Dis. Child.*, Jan., 1926, p. 58.

Cholecystography.—The author uses the intravenous technic with tetraiodophenolphthalein and also the oral technic, employing pills coated with stearic acid. He considers the intravenous method definitely more reliable and practically without risk. The oral method is more widely applicable. He has confirmed, in the human subject, the work of Boyden on laboratory animals, showing that a fat meal induces prompt and quite thorough emptying of the gall bladder. He discusses, but rejects, the theory that bile never leaves the gall bladder by way

of the cystic duct. He concludes that the so-called gall-bladder drainage by the Lyon method is somewhat less effective in emptying the gall bladder than a fat meal.

The article is most interesting in that it recites the history of cholecystography and cites the work of most of the experimenters along this line. These parts of the article, however, do not lend themselves to abstracting.

CHARLES D. ENFIELD, M.D.

Experiences with Cholecystography. L. R. Whitaker. *Jour. Am. Med. Assn.*, Jan. 23, 1926, p. 239.

Distribution of roentgen-ray intensity.—

The well known Dessauer charts for dosage in roentgen deep therapy have been the object of much discussion and criticism in this country, as well as on the continent. Dessauer has promised a thorough control investigation of his measurements, and two physicists of his institution present in this paper the results of their painstaking work on this problem. They compare the two methods mostly used in measuring depth intensities, the iontometric and photographic, the limitations of each being demonstrated by detailed tests. It is stated that the photographic, or film, method, as developed by Dessauer and Vierheller, has to be given preference over any other procedure for working out dosage charts. The discrepancy between their results and those of Holfelder are discussed at length. In concluding, the characteristic form of the original curve is confirmed, that means the existence of considerable roentgen intensity outside of the direct cone, supposing that the measurements are done under the same conditions as given by Dessauer. The position of the diaphragm plays a very important rôle. The scientific basis of a so-called "artificial surface," that is, the covering of the area to be treated with a layer of paraffin, is supported. A revised edition of the full set of charts will be published later.

E. A. POHLE, M.D.

The Problem of the Distribution of Roentgen-ray Intensity in an Irradiated Medium. E. Lorenz and B. Rajewsky. *Strahlentherapie*, 1925, Vol. 20, p. 581.

Diseases of nasal accessory sinuses.—The author finds that mapping the ethmoid sinuses within the bony landmarks is an uncertain method in many cases. He has used all the methods that he has been able to find reported and that of Granger has been found the most useful, but even this gives certain difficulties when used unmodified. After many trials he has adopted the 107-degree angle, stereo method, with an up-

ward shift of the tube, the patient being in the erect position to bring out fluid levels, as the most accurate for ethmoid and sphenoid interpretation. At first he used a 22-inch distance, which gave an excellent view of the ethmoids but not always of the sphenoid. At the suggestion of Dr. Chamberlain and Dr. Newell, the tube-plate distance was changed to 40 inches, which brought out shadows at a distance from the plate. With a 2½-inch shift there was little displacement of the petrous portion of the temporal bone and the ethmoids were not uncovered sufficiently to be ideal. The shift was changed to 5 inches and the result was found to be most gratifying, as one plate gave Granger's 107-degree angle position with curved line and the other gave an excellent view of the ethmoid capsule.

The stereoscopic image was quite as good as with the 2½-inch shift, and with more favorable uncovering of the pneumatic structures.

F. B. SHELDON, M.D.

The X-ray Diagnosis of Diseases of the Nasal Accessory Sinuses, with Special Reference to Sphenoid and Ethmoid Diseases. Robert A. Powers. *Calif. and West. Med.*, Aug., 1925, p. 1009.

Malformations of uropoietic system.—Congenital malformations of the uropoietic system are of great practical clinical importance. Practically all such cases require surgical intervention for relief. Present-day methods of urological and X-ray diagnosis render diagnosis more easily determined and treatment more readily carried out.

Anomalous ureteral terminations are classified as follows:

1. In the male genito-urinary apparatus: (a) bladder, (b) in the urethra, (c) in the seminal vesicle, vas deferens, ejaculatory duct, or prostate.
2. In the female genito-urinary apparatus: (a) in the urethra, (b) in the vagina, (c) in the vestibule of the vagina, (d) in Gartner's canal, (e) in the uterus or tubes.
3. In the bowel: (a) in the rectum and cloaca, (b) in the intestines, (c) in the urachus and amniotic cavity.
4. In cases of congenital absence of the bladder: (a) in the urethra, (b) in the vestibule of the vagina.
5. Blind endings.

Two cases with abnormal ureteral endings are reported in detail. Case 1 had two normal ureters and kidney pelvises, with an accessory ureter opening just below the symphysis pubis into the bladder. In Case 2, the ureteral opening was just inside the external urinary meatus

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and the tract extended along one of the normal ureters to be lost above the sacrum. At operation it was found to lead to the upper pole of the kidney.

A review of the literature has resulted in finding 98 reported cases; these, with the two here reported, make a total of 100 in all. These have been arranged in tables according to the type of anomaly, as follows: *Table I.* Single ureter with ectopic opening. *Table II.* Complete unilateral duplication of pelvis and ureter with an ectopic opening of the supernumerary ureter. *Table III.* Complete unilateral duplication of pelvis and ureter with ectopic opening of both ureters. *Table IV.* Supernumerary kidney, pelvis and ureter with an ectopic opening. *Table V.* Bilateral duplication of pelvis and ureters with one ectopic opening only. *Table VI.* Bilateral duplication of pelvis and ureters with bilateral ectopic openings. *Table VII.* Both single ureters having ectopic openings.

L. R. SANTE, M.D.

Ectopic Ureteral Openings: Surgical Significance and Treatment. Edward F. Kilbane. *Surg., Gynec. and Obst.*, Jan., 1926, p. 32.

Osteomyelitis.—The management of osteomyelitis is very unsatisfactory. The authors advocate subperiosteal resection of the bone, often taking out the entire shaft. The periosteal shell then is disinfected with 95 per cent phenol and alcohol and the sac closed. Bone formation is palpable in three weeks and usually a complete regeneration of the shaft can be expected—although this does not always occur. The extent of the disease and the condition of the bone can be seen on the X-ray film; the progress of bone regeneration can be followed after operation. A number of cases are described in detail.

L. R. SANTE, M.D.

Resection of Long Bones for Chronic Osteomyelitis. George I. Bauman and Horace E. Campbell. *Surg., Gynec. and Obst.*, Jan., 1926, p. 114.

Roentgen-ray effect on yeast.—The effect of roentgen rays on yeast was studied by measuring the CO₂ formation with an apparatus described by Heyduck. The dose given amounted to about 3 S.U.D., unfiltered, on the surface of the glass container. Several electrolytes were added to the yeast; a definite retarding effect on the fermentation was noted, when irradiated and compared with the same experiments while the yeast was suspended in sugar solution, which showed hardly any influence of radiation. If dry yeast was irradiated before using it for the fermentation test, no marked influence could be

demonstrated between the treated and untreated yeast. It seems, therefore, that the surrounding medium is of great importance for the effectiveness of radiation.

E. A. POHLE, M.D.

Studies of the Roentgen-ray Effect on Yeast. E. Schneider. *Strahlentherapie*, 1925, Vol. 20, p. 793.

Heliotherapy of surgical diseases.—The author, who inaugurated the use of natural mountain sun for surgical tuberculosis in 1902, discusses in this article the indication for its application for all kinds of surgical conditions; for instance, wounds, osteomyelitis, fractures, luetic ulcers, eruptions of the skin, surgical tuberculosis and rickets. Very interesting is the recommendation of sunlight for treatment of X-ray burns; the results are good, however, only in cases of moderate injury. Three cases of epithelioma of the ear, nose, and dorsum of the hand are quoted, which healed up entirely on sun treatment. The pathological diagnosis of one case was confirmed by biopsy.

E. A. POHLE, M.D.

Heliotherapy in Surgical Diseases. O. Bernhard. *Strahlentherapie*, 1925, Vol. 20, p. 479.

Carcinoma of the uterus.—In California the cancer mortality averages about 81½ per cent of the total deaths, and of these cancer deaths the genital organs furnish about 14½ per cent. The author believes that cancer starts from many cells simultaneously, rather than from a single cell. How long it takes for these cells to develop and the patient to become conscious of the disease is an unknown factor: the duration after the onset of symptoms is better known. The author believes that it is justifiable and ethical to inform women over 30 years old of the importance of routine pelvic examination at reasonable intervals, even though no symptoms appear.

Radium therapy is an invaluable addition to our armamentarium for the care of the cancer patient. It is undoubtedly curative when used early enough, and in frequent instances patients with advanced cancer have lived in comparative comfort after such treatment when all other resources of medicine and surgery have been exhausted. The author's present preference of treatment of early cancer of the uterus is radium and X-ray before operation; in about five weeks do a radical hysterectomy, with removal of the parametrium, and avoid post-operative radiation, except for recurrence. All suspected cancer patients are subjected to a curettage and excision of cervix specimen, inserting 100 mg. of

radium while waiting the frozen section examination. If the specimen is found to be malignant, the radium is left in for from 20 to 30 hours.

The radiation department advises in each case as to the need of deep therapy. In the average case treated the factors are: skin target distance, 50 cm.; 300 to 450 milliamperes minutes given through round port 25 cm. in diameter, centered over the front of the pelvis; $\frac{3}{4}$ mm. copper filter, and 200 K.V. The following day a similar port is radiated over the back.

Before 1921, 50 per cent of the cases were operated on. Since 1921, radium and the X-ray have been used more extensively, and only 15 per cent have been operated on. The time is too short to judge of the comparative values of radiation and operation, and the problem is further complicated because, since using the radium and deep X-ray therapy, although more patients are being received for treatment, the percentage of patients showing advanced cancer is much larger. The prognosis of early cancer of the uterus is so good, and the fatal outcome for advanced carcinoma of the uterus is so sure, regardless of treatment, that the greatest hope for reduction of the apparently increasing cancer death rate seems to lie in the routine examination, eradication of local and general irritations, pathologic diagnosis in suspicious cases, and in proven cases pre-operative use of radium and deep X-ray, followed in a few weeks by complete removal of the uterus and parametrium.

F. B. SHELDON, M.D.

Mortality Rates of Carcinoma of the Uterus in California. Alfred Baker Spalding. Calif. and West. Med., Oct., 1925, p. 1297.

A case of roentgen carcinoma.—The patient, a woman 33 years of age, was suffering from periostitis (tuberculosis?) in the left upper arm, in 1904. An incision was made and healing occurred. In 1914, a recurrence was treated by X-ray and ultra-violet radiation because the patient refused another operation. After 1916, only ultra-violet radiation was given. The total roentgen-ray dose amounted to 5 S.U.D., through 3 mm. aluminum. In 1919, an ulcer formed over the place of exposure, and a biopsy resulted in a diagnosis of carcinoma. Under radium and roentgen therapy, the lesion improved. After an injury in December, 1923, a vesicle, filled with blood, formed on the site of the previous ulcer and developed into a slowly growing tumor. The patient was admitted to the hospital in 1923, where an excision of the tumor mass, which covered the greater part of the left upper arm, leaving only a small strip of normal skin on the inner side, was done, followed by

transplantation, to save the arm of the relatively young patient. Very soon, local recurrences appeared, which were treated with radium. In March, 1925, infection of the arm and high temperature made an amputation necessary. The patient died, however, in April, 1925. Autopsy was not done. The author diagnoses this case as one of very definite roentgen carcinoma.

E. A. POHLE, M.D.

A Case of Roentgen Carcinoma. H. Apperath. Strahlentherapie, 1925, Vol. 20, p. 576.

Diagnosing carcinoma.—The authors, discussing the diagnosis of carcinoma of the colon and rectum, remark that it is only by most painstaking investigations, aided by proctoscopy and X-ray examinations, that cancer of the colon and rectum can be recognized sufficiently early to afford a reasonable expectation of radical cure from operation. A progressive secondary anemia and an irregular type of temperature may be early signs, and symptoms of gastric disturbance, with absence or diminution of free hydrochloric acid, may occur in early cases, together with local and general abdominal discomfort, with pain and colic. Constipation, sudden or gradual in onset, is frequently the earliest sign, and this, combined with the presence of occult blood in the stools, in a patient over forty years of age is very suggestive of carcinoma of the colon and rectum. An X-ray examination often affords the only means of making an early diagnosis, and this, together with procto-sigmoidoscopy, should never be neglected in all chronic bowel disturbances. Symptoms of obstruction, the presence of a palpable mass, the discharge of blood-stained mucus, and ascites and edema are among late manifestations. It is stated that in carcinoma of the gastro-intestinal tract a characteristic blood sugar tolerance curve exists differing from that seen in carcinoma of other regions. This may be of value in the differential diagnosis between carcinoma and other gastro-intestinal diseases. The difficulties and importance of early diagnosis are evident, seeing that in the authors' opinion operation offers the only cure, and that only when an early diagnosis has been made.

Some Observations on the Diagnosis of Carcinoma of the Colon and Rectum. J. Friedewald and L. J. Rosenthal. Med. Jour. and Rec., Oct. 21, 1925, p. 447. (Reprinted by permission from the Brit. Med. Jour., Dec. 5, 1925, p. 83 of Epitome of Current Medical Literature.)

Cancer of male breast.—Carcinoma of the male breast is relatively infrequent. In this series, 1,751 were in the female breast and 17

in the male breast. In males it usually occurs some time later than in females—probably due to the difference in function in the male and in the female breast. In this series, the oldest was 72 years of age and the youngest 38 years—average age 52.6 years. Carcinoma of the male breast has been noted in young boys 12 and 14 years old.

Pain, bloody discharge from, and retraction of the nipple, and ulceration, vary with the type, situation and extent of the carcinoma, the variation being similar to carcinoma found elsewhere in the body. In all 17 of these instances of carcinoma in the male breast, in this series, radical operation was performed. One died at operation; 11 of the 16 had one or more post-operative roentgen treatments. Average duration of life after operation was 22 months, although one remained well for 6 years.

CONCLUSIONS

1. It is probable that carcinoma of the male breast in most instances is a highly malignant type of neoplasm.

2. The results of radical operation for cancer of the breast are not as satisfactory in males as in females, very likely because in the former the tumors are generally of a higher degree of malignancy.

3. Tumors in the male breast should receive immediate radical operative treatment.

4. Good results are obtainable only by radical operation before glandular or other metastatic lesions occur.

5. Roentgenological treatment post-operatively does not seem to have arrested the progress of the disease to any appreciable extent in this series of cases.

L. R. SANTE, M.D.

Carcinoma of the Male Breast. E. Starr Judd and Harry D. Morse. *Surg., Gynec. and Obst.*, Jan., 1926, p. 15.

Lipiodol.—There are two methods of injection: (1) Curved trocar through the crico-thyroid membrane under local anesthesia; (2) Cocainization of the larynx and injection of the solution into the trachea under direct observation. In the experience of the authors, the second is the better method, as it is quickly accomplished, the average patient is perfectly comfortable, there is little tendency to cough, and the material is retained sufficiently long to permit observation in several positions. The material being heavy it drops into the most dependent portion of the lung; therefore the patient should be so placed that the suspected area is below the level of the trachea. When small amounts of the oil are used in continuous injections one

part of the lobe may receive it all, and when once so placed it does not tend to spread throughout adjacent areas. Multiple injections tend to equalize the distribution. It is a good plan to turn the patient from side to side, and stand him on his head over a chair or bed in an effort to drain the lesion before attempting to fill it. In normal individuals the fluid gives a thin coating to the larger bronchi and in filling the smaller ones gives a diffuse, flocculent shadow which is characteristic. Dilated bronchi are obvious, and the multiple grape-like masses in the small bronchiectatic cavities are easily recognized. No untoward effects have followed any of the injections. The therapeutic effects of the iodine injected are still a matter of discussion.

F. B. SHELDON, M.D.

Lipiodol in the Diagnosis of Chest Disease. Howard E. Ruggles and Lloyd Bryan. *Calif. and West. Med.*, Oct., 1925, p. 1280.

Roentgen therapy of lupus vulgaris.—The author has studied the cases of lupus vulgaris that have passed through Jesionek's clinic during the last three years, having been treated in other institutions with ultra-violet light and radium. They all showed recurrences, either in the edge of the primary treated lesion or even in its center. The cosmetic result was discouraging. A serious warning is, therefore, issued against the roentgen therapy of lupus vulgaris because it is ineffective, destructive, and leads to the most disfiguring scars. There are harmless and more effective methods, as, for instance, a general systemic treatment supported by local applications of ultra-violet radiation.

E. A. POHLE, M.D.

The Question of Roentgen Therapy of Lupus Vulgaris. S. Bommer. *Strahlentherapie*, 1925, Vol. 20, p. 523.

Pneumoperitoneum.—The development of artificial pneumoperitoneum as an aid to abdominal and pelvic diagnosis, is reviewed. The methods worked out by Peterson and Van Zwaluwenberg—modified knee chest position—have been found best for practical purposes. To this technic they have added the use of the Bucky diaphragm and have secured even greater detail; not only the uterus but tubes and ovaries can be clearly shown. Numerous interesting conditions are illustrated, among them, bilateral ovarian cyst, chronic salpingitis with adhesions, multiple fibroids and ruptured ectopic pregnancy.

CONCLUSIONS

1. Roentgenography after gas inflation of the abdomen is of material aid in gynecological diagnosis.

2. It is not a routine measure, the usual gynecological examination sufficing ordinarily.

3. In obese, unco-operative, ignorant, or mentally deficient women it may be the only means of accurate diagnosis before operation.

4. Its value lies not alone in positive evidence but also negatively in allaying suspicion of pregnancy or pelvic lesions with few palpatory findings. As a *matter of record* it has great value.

5. It is a safe method—no accidents occurring in the author's series of about 150 cases (Peterson's over 300). Two accidents per 1,000 are reported in the literature (Coliez).

6. The uterus, ovaries and fallopian tubes, round ligaments, and bladder can be clearly depicted on the X-ray film by a careful technic.

7. Pelvic pathology is graphically shown by silhouetting the viscera on the film after surrounding them with gas. Tumors are readily differentiated.

8. Carbon dioxide is preferred to air or oxygen because of more rapid absorption. All three gases are safe.

9. The transuterine route is preferable when the Rubin test proves the tubes permeable. The latter procedure is of distinct value in sterility, both diagnostically and therapeutically.

In the author's hands the roentgenogram was in some instances the sole means of accurate diagnosis. In others it was the deciding factor in settling differences of opinion. In still another group it portrayed normal pelvic viscera when history and opinion indicated otherwise, and proved of great value as a matter of record.

L. R. SANTE, M.D.

Roentgenographic Diagnosis in Gynecology; Pneumoperitoneum. Irving F. Stein. *Surg., Gynec. and Obst.*, Jan., 1926, p. 83.

The ultra sun lamp in otolaryngology.—The author reports his experience with the ultra sun light (Landeker and Steinberg) in otolaryngeal cases. This light is a carbon arc light with a spectrum very similar to that of the sun. It is recommended because mucous membranes can be treated without any irritation and under control of the eye. This is explained on the basis of clinical histories. The results were very satisfactory in cases of otitis media, laryngitis, and tuberculosis of the larynx.

E. A. POHLE, M.D.

Treatment with Non-burning Ultra Sun (Landeker and Steinberg) in Otorhinolaryngology. G. Strauss. *Strahlentherapie*, 1925, Vol. 20, p. 655.

Roentgen therapy of the othematoma.

In this report from a Vienna clinic, the treatment of all fresh othematoma with roentgen rays is recommended as the method of choice. It is essential that all irritations be strictly avoided. Usually only one exposure through 3.0 aluminum over the lesion with 3 H (about 30 per cent S.U.D.) is required; the dose may be repeated after fourteen days. In old cases surgery is to be preferred.

E. A. POHLE, M.D.

Roentgen Therapy of Othematoma. L. Forschner and E. Regnier. *Strahlentherapie*, 1925, XXI, 91.

Bactericidal substances after irradiation.

The surgical clinic in Worms, Germany, has devoted considerable time to study the effect of roentgen rays on inflammatory processes. They have developed a well founded technic which is gaining more and more recognition. In this paper, an attempt is made to prove, experimentally, the formation of bactericidal substances in blood, pus, and serous fluids after irradiation with the method of Dresel. The result is that in blood, sometimes in pus, but in none of the serous fluids (except one single case), a definite increase of the bactericidal power can be demonstrated after applying medium doses of roentgen rays.

E. A. POHLE, M.D.

Bactericides after Roentgen Radiation. C. Fried. *Strahlentherapie*, 1925, XXI, 56.

Osteoma of the frontal sinus.—A man, aged 32 years, complaining of headache and excruciating pressure pain in the region of the right orbit, showed undue bony prominences over the right frontal sinus. The eye was displaced downward and outward. The vision was normal and the eye-grounds clear. The excursions were not limited. No dizziness or nausea; Wassermann was negative. An X-ray examination revealed a large tumor mass practically filling the entire frontal sinus, which was large. The mass also extended into the orbit to the midline of the frontal region, laterally into the temporal bone, and posteriorly in the right anterior cerebral fossa. Under local anesthesia a large mass was removed, which was of almost ivory hardness and a surface rough and nodular. It was a benign tumor involving the entire right frontal sinus, the roof of the orbit, the intermedial wall of the two frontal sinuses, and lying upon the dura over the anterior frontal fossa.

B. C. CUSHWAY, M.D.

Osteoma of the Frontal Sinus Extending into the Orbit and Anterior Cerebral Fossa. Henry M. Goodyear. *Laryngoscope*, Oct., 1925, 751.

Carcinoma of stomach.—The presence of free hydrochloric acid cannot be regarded as evidence against the diagnosis of a growth. On the other hand, complete achlorhydria is present in 4 per cent of normal young men (Bennett and Ryle). With good technic and an experienced observer some abnormality suggestive of growth can be discovered with the X-rays in almost every case.

Though a definite deformity can generally be recognized in the outline of the stomach in good radiograms, it is remarkable how normal the appearance may be even with growths of considerable size. For this reason, fluoroscopic examination is of still greater importance, especially with early growths involving the pyloric half of the stomach. In most of the cases careful observation reveals some abnormality in the peristaltic waves. Instead of becoming slowly and gradually deeper as they approach the pylorus they may disappear entirely or they disappear and reappear an inch or more further along the curvature. Hurst has often observed this in the absence of any permanent filling defect which could be recorded on a radiogram.

Until recently great difficulty was experienced in deciding whether pyloric obstruction was due to cancer or some other cause. This difficulty can be overcome by completely emptying the stomach before the opaque meal is given.

In pyloric obstruction the stomach always contains food fluid and often some food residue. Consequently, when the opaque meal is swallowed it drops to the bottom of a distended stomach. The transparent gastric contents are generally not observed; a diagnosis of dilatation due to obstruction is made, but as the opaque meal lies in the most dependent part of the stomach, the immediate neighborhood of the obstruction is not clearly seen. After being evacuated, it is found that, though previously distended, the stomach is not permanently dilated, as it nearly always contracts to a normal or almost normal size. Consequently an opaque meal taken now fills the stomach in a normal manner and the outline of the pyloric end of the stomach and the progress of the peristaltic waves from their commencement to their end can be satisfactorily investigated.

The discovery of occult blood in the stool is of the utmost importance. The writer has never seen a case of carcinoma of the stomach or of the colon in which occult blood was not present. In these cases occult blood persists however long the treatment continues and however well the patient appears to get.

S. FINEMAN, M.D.

Auxiliary Methods of Diagnosis [of Cancer of Stomach].—Radiological and Clinical. Arthur F. Hurst. Brit. Med. Jour., Nov. 14, 1925, p. 879.

Irradiation of embryonic tissue.—The author irradiated tissue cultures of the chicken embryo and the spleen of rabbits *in vitro* with the same dose of filtered radiation; the latter showed definite signs of injury, while the former continued to grow. If a fertilized egg of a chicken was subjected to the same treatment, the embryo was killed in a short time. An explanation made of this irradiated embryonic tissue always grew as the untreated controls. It is concluded, therefore, that a differentiation must be made between the primary effects of radiation on a certain form of tissue *in vitro* and the secondary effects taking place if this tissue is left in the body. The high sensitiveness of embryonic tissue evidently does not hold true, but seems to apply only to embryonic organism as a whole.

E. A. POHLE, M.D.

The Analysis of Roentgen-ray Effect on the Embryo and Embryonic Tissue. A. A. Krontowski. Strahlentherapie, 1925, XXI, 12.

Multiple myeloma.—This disease is characterized by multiple lymphocytic, myelocytic or plasma cell invasion of the bone marrow throughout the body, destruction of the bone resulting. The clinical course of this disease closely resembles sarcoma except for its wide distribution and the fact that lesions are always multiple. No evidences of metastasis to other portions of the body are found. This disease is really of malignant character, slow growing and rather rare in occurrence. The favorite site is in the flat bones, the long bones being involved later. The disease is rare and difficult, if not impossible, to diagnose by the X-ray alone.

Diagnostic points.—The lesions are multiple and the bones are pierced by small focal spots of destruction. The tumors do not extend out into the distal cortex. A marked rarefaction of the affected bones occurs. There is a thinning of the cortex; pathological formations are common. Bence-Jones bodies are found in the urine. X-ray therapy relieves pain but does not cure or abort the disease.

Case report.—A woman, aged fifty-eight, entered the hospital, Dec. 5, 1922, and left Jan. 11, 1923. The diagnosis was multiple myeloma of the bone. The history was as follows: Five months before admission she had felt sudden pain in the right leg while lifting. The pain disappeared in two weeks' time. Later she experienced pain in the left hip. This pain caused her to bend backward while walking. The physical examination was negative. The blood count revealed secondary anemia: red cell count, 2,600,000; hemoglobin 60 per cent; white cell count normal; Wassermann negative. The urinalysis report gave urea nitrogen 5 mgm. per 100 c.c. No evidence of albumen or sugar. The

roentgen-ray examination showed practically all of the bones to be invaded by a multiple myeloma.

Second admission to the hospital for X-ray treatment on Feb. 27, 1923, to March 21, 1923. The hemoglobin at this time was 74 per cent, the red cell count 3,180,000.

Third admission to the hospital on May 29 to May 31, 1923. No change in the condition reported.

Fourth admission to the hospital March 22, 1924. Three months previous she experienced a fracture of the left femur. A pathological fracture of the right femur was also found upon examination. The roentgen-ray examination further revealed pathological fracture in both femurs. The pain was relieved by morphine. Roentgen therapy was stopped because of the seeming tendency of this therapy to be conducive to the production of pathological fractures. The tumors were reported to be advancing in all of the bones. The patient was still alive more than three years following the onset of the symptoms of this disease. Hence no report of a postmortem character could be made at this time.

B. C. CUSHWAY, M.D.

A Case Report of Multiple Myeloma. Webster W. Belden. Am. Jour. Roentgenol. and Rad. Ther., May, 1925, p. 442.

Cholecystography.—This is a report based on 53 cases controlled by operation. The authors used the intravenous method of injection. Sodium tetraiodophenolphthalein was used in all cases, the dosage varying from 5.5 grams to three-quarters of this amount. In no case did any alarming symptoms occur. The writers conclude that when a gall-bladder shadow is visible, of normal density and contour, gross disease may be excluded, but mild cholecystitis may be present. Gallstones casting no shadows in the ordinary radiograms may be shown up as negative shadows. Given correct technic the absence of a gall-bladder shadow indicates one of three conditions:

- (1) Obstruction of the cystic duct by a stone within it, or by fibrosis catarrh, or neoplasm.
- (2) A gall bladder so filled by stones that dye-laden bile cannot enter.
- (3) A gall bladder so diseased or shrunken as to be functionless.

The authors have used the test in eight cases of obstruction jaundice. In four cases there was no reaction, in four slight nausea, and in two transient vomiting. In no case was any shadow visible in gall bladder or ducts.

The authors have used the oral method in but a few cases. The results were so inferior to those obtained by the intravenous administration of the dye and the latter so much more accurate and certain that it is now practised by them exclusively.

S. FINEMAN, M.D.

Cholecystography. D. P. D. Wilkie and C. F. W. Illingworth. Brit. Med. Jour., Dec. 5, 1925, p. 1046.

Hypophysis and climacterium.—In this third article, Borak discusses the correlations of the inner secretory glands in regard to the symptoms of the menopause. He believes that all disturbances during that time are due to a hypertrophy and hyperfunction of the thyroid, suprarenals, and hypophysis, and not to the lack of ovarian secretion. Irradiation of the hypophysis is warmly recommended to overcome climacteric symptoms. A total dose of 30 per cent S.U.D. on the hypophysis, with filtered radiation, through three or four fields of entry, are given. This dose may be repeated in from four to eight days. It is advisable to treat the thyroid gland also, chiefly if no relief is secured with the exposure of the hypophysis.

E. A. POHLE, M.D.

The Roentgen- and Organotherapy of Inner Secretory Disturbances. III. Correlations of the Inner Secretory Glands during the Climacterium. J. Borak. Strahlentherapie, 1925, XXI, 31.

